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UNITED STATES
DEPARTMENT OF AGRICULTURE
FARM SECURITY ADMINISTRATION
WATER FACILITIES PROGRAM

FARMSTEAD WATER SUPPLY
PLANNING, ESTIMATING & CONSTRUCTION
MANUAL

REGION VIII
TEXAS, OKLAHOMA AND NEW MEXICO

Revised February, 1946

FOREWORD

The purpose of this manual is to provide guidance and such engineering assistance as may be required by the County FSA Supervisor in preparing loan applications and supervising installations of simple type water facilities such as wells, windmills, pumps and pressure systems. On all other types of facilities such as cisterns, ponds, spring development, deep wells, or other complicated construction, special engineering assistance is available and should be requested. In many cases engineering assistance can be given by correspondence if the County Supervisor will forward a tentative copy of the 656A to the Regional Office for review and approval before completing the docket.

Material in this manual has been compiled from various sources, however, no attempt was made to give credit to any particular origin of information.

FARMSTEAD WATER SUPPLY
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MANUAL

INTRODUCTION

This manual has been prepared for the purpose of conveying to field personnel, in non-technical language and condensed form, some of the general principles to be considered in planning and developing farmstead water supplies for domestic and live-stock use.

The discussions and specifications which follow are not expected to solve all of the problems encountered in the field, but are intended for use as a guide in planning, in the selection of equipment and materials, and toward good construction methods, whereby a farmstead water supply may be developed that is safe, dependable and adequate.

SAFETY OF SUPPLY

Water for domestic use must be safe, and should be potable. Safe, potable water will not cause disease. It is clear, odorless, neither strongly acid nor alkaline, and is suitable for general domestic and livestock use. The safety of a water supply should be determined periodically. State Health authorities will usually make these determinations if samples of water are properly collected and submitted to them. A water sample should not be located where there is a possibility of contamination from barnyards, stock lots, outdoor toilets, septic tanks or cesspools.

DEPENDABILITY OF SUPPLY

Every effort should be made to determine the availability and dependability of a water supply before development is undertaken. This may be accomplished in the following manner.

a. Conduct a pumping test on existing wells to establish the quantity of water available and the pumping level, (the depth from ground surface to the water when the pump is operating).

b. For new construction, investigate existing wells in proximity to the site and obtain, if possible, depth of hole, quality of water, pumping level and well log.

c. Obtain information from local well drillers regarding depths from which acceptable water may be obtained, also costs for drilling and casing of wells.

d. Where a spring development is contemplated, determine if possible the supply of water available during periods of drought.

ADEQUACY OF SUPPLY

In order to arrive at the adequacy of a water supply the anticipated total daily consumption must be known. Table 1 sets forth estimated requirements that are considered to be a safe basis for estimating total daily consumption.

WELLS

Wells for domestic and livestock purposes in this region may be classified as follows:

1. Drilled
2. Dug
3. Sand Point or Driven
4. Seep

In selecting the location for a well the following data should be checked:

1. Relative elevation with respect to flood conditions
2. Direction of surface water run-off
3. Probable direction of ground water flow
4. Possible sources of contamination such as privies, cesspools, sewer lines, sink holes, abandoned wells, barns, stock lots, stables, and polluted streams
5. Availability of sufficient potable water at reasonable depths.

DRILLED WELLS

In all instances where ground water conditions permit their use, drilled wells will be found to be most satisfactory and economical. Local practices generally will control the methods to be used in drilling and casing of wells. It is recommended that well drilling be executed under contract wherever possible; and that the contract includes drilling, casing, cementing (when necessary), screen (when required), concrete slab at well top, and pumping equipment completely installed in order to insure all of the work being done by workmen skilled in this particular type of installation.

A complete and accurate log of each well should be made recording the different types of soil and the depths (measured from normal ground) at which they are encountered. The log should further indicate the depth to water bearing stratum and the distance into the stratum that the well is drilled. Well data should include the level of the water in the well before pumping; the rate in gallons per minute of the pumping test and the time consumed; the draw down in feet (difference between water level before pumping and water level during pumping test); the pump setting (depth from ground surface at which the cylinder or the bottom of suction pipe is placed); and such other informa-

tion as requested on Form FSA-498, Exhibit A, a completed copy of which should be forwarded to the office of the Regional Engineer.

The diameter of the well or casing is governed by the quantity of water required. It is seldom that a casing larger than six inches in diameter will be required for a domestic and livestock water well, and casings of less than four inches in diameter are not recommended.

Sheet metal casing is not recommended due to its inability to withstand ground movement which may cause it to collapse, with the result that both the well and pumping equipment may be lost. In areas where the ground water is of such quality as to require galvanized casing, galvanized standard weight steel pipe should be used.

The well should be drilled straight to avoid any interference with the free operation of the pumping equipment, and should extend into or through the water bearing sand.

The following paragraphs briefly describe several of the commonly accepted methods of installing casing and screen in drilled wells:

1. Where water is to be taken from one or more water sands, there being no upper water to be shut off, the casing may be set to the bottom of the lowest sand with a perforated section of casing or a screen inserted at each sand.

2. Under the same conditions as outlined in (1) above, the casing may be set above the upper sand and supported by grouting with cement, by an expanding packer, or by being driven into a dense formation such as rock, clay or shale. The remainder of the hole is then drilled through the casing to the bottom of the lowest sand. Another casing or liner, one or two sizes less in diameter, is then set to the bottom of the hole with a perforated section, or a section of screen inserted at each sand, the upper end of this casing or liner projecting into the first casing approximately five feet and sealed thereto with an expanded lead seal.

3. Where there is only one available stratum consisting of very fine sand, and the depth at which it lies prohibits the installation of a dug well, a drilled well may be completed by drilling the hole and setting casing one foot into the sand. The casing is then supported at ground surface by a steel clamp as shown in Figure 1. Perforated casing or screen is omitted and development is accomplished by the application of 1/4" disinfected pea gravel through the casing or through the annular space around the casing.

During application of the gravel, bailing is continued to remove sand and to permit settlement of the gravel at the bottom of the casing in sufficient quantity to form a pocket large enough to effectually shut off the sand. Drilling tools are sometimes used to pack the gravel. This type of well generally should not be pumped to capacity in order to avoid disturbance of the gravel.

In some localities, it will be found that ground water conditions require the shutting off of highly mineralized or salt water which may lie above the stratum to be developed. In this case it may be necessary to completely seal the casing throughout its entire length, or from the bottom to a point at least ten feet above the stratum to be shut off, by grouting. The grouting of wells in this manner is recommended when there is any question as to proper and efficient sealing at the base of the casing.

The grout is composed of neat cement with sufficient water to render the mass workable, and to be effective it must be applied through the casing, and forced upward into the annular space between the casing and drill hole walls.

The sanitary requirements of drilled wells are the same as for other wells. Figures 1 & 2 show the proper method for finishing the top of drilled wells for two different types of pumping equipment.

DUG WELLS

In some areas ground water conditions may be encountered which render impracticable the installation of drilled wells. In such areas the construction of dug wells may be given consideration.

Due to their susceptibility to contamination, particular care should be taken both in locating, and in the construction of dug wells in order to provide proper sanitary protection.

All dug wells should be a minimum of 3 feet inside diameter to permit entrance for cleaning purposes. The hole should be dug straight, and for the upper 10 feet should be 10 inches larger in diameter than the remainder of the hole to allow for a concrete sanitary seal. The depth of the well will depend upon the location. Average depth of well for any locality can be estimated by talking to local drillers or inquiring as to depth of wells on adjoining farms.

The well casing or curbing may be formed of common brick laid flat, or concrete pipe, and should extend through the water bearing formation and rest on the underlying rock or clay.

If common brick is used, all brick work through the water bearing stratum should be laid without mortar, all brick work above the water bearing stratum should be laid in cement mortar.

If concrete pipe is used, the bottom joint should be perforated through the water bearing stratum.

The well curbing should be brought up to at least one foot above the ground level, and the concrete seal should then be poured around the curbing and brought level with the top of the curbing.

The concrete cover may be pre-cast and then placed over the well. In casting the cover, care should be taken to see that anchor bolts for the pump standard are properly placed and that the necessary slope is given to the top to drain off rainwater.

Figure 3 shows the general type of construction of brick and concrete pipe curbing for dug wells.

SAND POINT OR DRIVEN WELLS

Figure 4 shows the general construction of a sand point well in which a surface casing is set to a depth of not less than 10 feet and cemented for sanitary protection and the well top finished with a concrete slab. The use of 2" drop pipe and a 1-7/8" working barrel permits replacement of cup leathers without removing the pump stand or drop pipe.

SEEP WELLS

In some areas satisfactory ground water is unobtainable and the average rainfall is insufficient to maintain a cistern supply for domestic use. The common practice in such areas is to provide farm ponds which furnish both livestock and domestic water. It is necessary, therefore, to exclude all livestock from the pond and its immediate drainage area, and to install a sand filter and clear well. Figure 5 illustrates this type of installation. Mechanical pumping equipment should be installed to distribute the water from the clear well to stock troughs, to points throughout the farmstead and to a storage tank at the dwelling for domestic supply. Contrary to popular belief, a sand filter will not remove all harmful bacteria from the water. In order to insure the safety of the domestic supply it will be necessary, with this type of installation, to chlorinate the water in the storage tank at the dwelling each time the tank is filled.

CISTERNS

Brick, concrete, and cement plaster are the most commonly used materials for the construction of cisterns.

The soil in some areas is of such nature that a reasonably durable cistern can be made by plastering directly on the earth wall. This type of cistern can be constructed without the use of forms and with less material, but it is not as strong and durable as the brick or concrete cistern. The walls are thinner and crack easier, and unless the cistern is constructed in a good, firm, well drained

soil, the results secured are likely to be disappointing. The cement-plaster cistern should always be circular in shape.

Brick cisterns are satisfactory and can be constructed without the use of forms, but skilled labor for laying the brick is desirable. They are usually circular in shape with a jug-shaped neck. The neck is formed by drawing in each layer of brick as the neck is built up. It is necessary to plaster the inside of this type of cistern with a thick, rich cement mortar to make it water-tight. The outside of the jug neck should also be plastered to a sufficient depth to cut off outside seepage.

In some localities concrete is becoming the most popular material used for the construction of cisterns. Concrete cisterns may be square, rectangular, or round. Square or rectangular cisterns have several disadvantages that more than offset their apparent ease of forming:

1. Thicker walls and more reinforcing are required in order to give the necessary strength.

2. This type of cistern is subject to cracking at the corners.

3. More material is required in the top and bottom than in a round one of the same capacity.

4. More form lumber is required.

Figures 15, 16, and 17 show typical designs.

Other cistern types which have proven satisfactory under certain ground conditions may be constructed, and cisterns of larger storage capacity of the types shown may also be constructed, provided, that a sketch showing all dimensions, materials and cost estimate be submitted to the Office of the Regional Engineer for approval, and such approval be received before commencing construction.

Cisterns receiving water from irrigation canals should be equipped with the filter shown on Figure 15. Cisterns receiving rainwater should be equipped with the filter shown on Figure 16.

When a filter is properly constructed and operated, it will do a great deal to assist in removing suspended matter or sediment, but it does not remove dissolved minerals or bacterial contamination.

The filter should be cleaned regularly by removing the layer of clogged filtering material and replacing with clean fresh material.

Estimates for gutters and downspouts may be obtained from local hardware dealers or sheet metal shops, and since the proper

installation of these items requires special tools and equipment, it is recommended that estimates include both materials and installation.

SPRINGS

Springs are the natural emergence of ground water that find their way to the surface through crevices or porous earth strata. They are of all gradations between concentrated outflows emerging from the ground at a single point or within a restricted area, which are characteristic of true springs, and the diffused emergence of water over large areas, which is characteristic of general seepage.

Before developing a spring for domestic purposes, a survey should be made of all existing or proposed buildings, sewage disposal works, drainage, and any other conditions which may affect the water supply.

To develop a spring, it is necessary to clean out the opening, locate the true water-bearing outcrop, and provide means for collecting and utilizing the outflow. The spring should be protected from surface damage, and suitable cribbing and collecting facilities should be provided to keep the collection sump and inflow channels open. Since the flow of a spring is dependent on the head of water, any attempt to raise the outlet in order to gain elevation may result in a decreased yield, or even cause the spring to change its course and emerge at some other point.

It is often difficult to determine the most suitable form of spring development until some excavating has been done and an investigation made. Before undertaking an extensive development, it may be advisable to make numerous test borings in the immediate vicinity of the spring to determine the approximate water table profile and the extent and direction of movement of the water. A study of the relative heights to which water rises in a group of test holes will make it possible to plan a better collection system.

Springs satisfactory for household use generally emerge from hillsides, and the inflow is in a downward or horizontal direction. The water percolates from passages or numerous small openings in the permeable material, which overlays a less pervious stratum. The discharge may be restricted to one point or to a limited area, or it may extend a considerable distance across the slope. A suitable development must intercept the flow and collect it at some central point. Vertical excavation or borings through the impervious stratum may result in complete or partial loss of spring flow.

A V-shaped collecting wall with the ends extending back into the hillside to divert the water to a central point at the

apex is often used. See Figure 18 for details. A concrete collecting wall is preferable, and it should be at least six inches thick, with the ends extending far enough back into the hillside to prevent outcropping water from going around them. The wall should extend one or two feet above ground level, and should be carried deep enough to reach a good foundation and prevent underseepage. A box encasement with removable cover may be constructed in the apex of the V-shaped wall to make inspection and cleaning easy. The upper side of the box must be made pervious, and a generous amount of clean sand, gravel and rock should be filled in behind the spring box and collecting wall to facilitate the passage of water. The porous material should then be covered with soil of a depth sufficient to completely bury the wall and prevent the entrance of snakes, frogs, or vermin. Where spring water emerges at several widely spaced points, coarse gravel and rock filled ditches, or preferably, open-jointed tile embedded in gravel-filled ditches can be used to advantage for collecting water from outlying points, and thus the expense of extending collecting walls long distances into or along the hillside is eliminated.

All springs should be protected from surface run-off by a suitable diversion ditch, and they should be enclosed by a substantial fence to exclude livestock.

REPAIR OF EXISTING WALLS

Existing domestic wells which may be subject to contamination should be repaired and properly sealed. Dug wells with stone or brick curbing may be repaired by encasing the curbing with concrete, or by removing and curbing to a depth of 10 feet and replacing with concrete. In either case a concrete cover should be installed to seal the well top and support the pumping equipment.

Often, in the case of dug wells, it becomes necessary to clean out all sand, silt and foreign matter. Care must be exercised on entering wells that are deep and which have been closed for a period of years, as they may contain dangerous gases or a lack of oxygen which may asphyxiate a man before he has an opportunity to come out. Before any such well is entered, it should be opened for several hours, and then a lighted lantern should be lowered to the top of the water. If the lantern continued to remain lighted, it should be reasonably safe to enter the well.

Drilled wells will frequently be encountered, where the casing has originally been finished level with ground surface. Under such conditions it is not possible to execute repairs which will meet minimum sanitary standards without extending the casing above ground surface a sufficient height to permit the installation of a concrete slab. Figure 27 shows a method for

making such repairs where welding equipment is not available. One of the most important items to be observed both in repairing and in new construction of drilled wells is the 1" projection of the casing above the concrete slab. If the slab is finished level with the top of the casing, proper sanitation of the well cannot be maintained.

Where wells prove unsatisfactory and are abandoned, all reclaimable materials should be removed and the well hole plugged with concrete to prevent surface pollution reaching the underground strata through the hole. Under no conditions should an abandoned well be used for the disposal of sewage or other waste.

DROP PIPE

All drop pipe should be standard galvanized pipe, plugged and reamed to remove excess galvanizing material which might destroy cup leathers. It is advisable to use a pipe having an internal diameter of the next standard size larger than the cylinder to permit removal of the valves and plunger without pulling the drop pipe. The pipe should extend far enough into water so that the well may be pumped continuously at its rated capacity without danger of exposing the suction stub.

The pipe must be suspended by the use of a clamp or a hand pump standard. A cast iron pipe holder with set screws is the most satisfactory method to support the pipe if a hand pump standard is not used. A coupling, tee or other fitting should be screwed to the pipe just above the pipe holder so that the fitting rests on, and the weight of the pipe is carried by the pipe holder.

An asphaltic seal is recommended between the pipe holder and pipe, and pipe holder and casing. Figures 1 and 2 show these two commonly accepted methods of supporting the drop pipe.

CYLINDER

The two most commonly used cylinders are designated in equipment catalogs as deep well and shallow well types. The shallow well cylinder is larger in diameter than the pipe tappings in the end caps, necessitating the removal of the drop pipe for plunger and valve repairs. This type should be used only at the insistence of the cooperator after its disadvantages have been explained to him.

The cylinder size is determined by the pumping rate, well depth and size of wheel if a windmill is used. It is advisable to select a cylinder having a slightly less capacity than that of the well to permit continuous pumping without danger of lowering the water to the point where the suction stub is exposed. For windmill operation the size of the

cylinder and the wheel should be such as to produce 1/8 of the total daily water requirement in one hour with average wind velocity for the area. Local dealers can supply data and assist in selecting the proper size of cylinder and windmill to meet this requirement.

In order to provide frost-proof installations, a weep hole should be drilled in the drop pipe below the frost line to drain the pump and upper portion of the pipe.

PUMP ROD

Wood and galvanized steel pump rod are both commonly used. Wood pump rod should be equipped with galvanized couplings securely fastened with copper or galvanized rivets.

PUMPS

Pumps for use in connection with farmstead water supplies may be classified as "Shallow Well Pumps" and "Deep Well Pumps".

Shallow well pumps may be piston type or centrifugal type and should be used only when the total lift is 22 feet or less. There being no moving parts below the cylinder or impeller, it is not necessary to place these pumps directly over the well. The distance from the well at which they may be located is governed by the actual vertical lift in feet plus the additional lift created by friction losses in the suction pipe between the well and the pump, the total sum of which should not exceed 22 feet. For example, it is decided to install a shallow well pump 75 feet from the well. The pump capacity is 5 gallons per minute, the suction pipe is 1" diameter and three 90° ells will be required. The pump location is such that the vertical distance from the center line of the pump to the low water level in the well is 18 feet.

To arrive at the total lift created by the above stated conditions, the friction losses in the 1" horizontal pipe must be determined, and expressed in terms of lift in feet, and then added to the vertical lift.

In solving the problem the first step is to determine the total length of 1" pipe or the equivalent thereof, and the conditions show that 75 feet of 1" pipe and three 1" - 90° ells are required. Reference to Table 3 shows that a 1" - 90° ell has an equivalent value of 6 feet of 1" pipe. The three 1" ells therefore equal 18 feet which added to the stated 75 feet, make a total equivalent length of 93 feet of 1" pipe.

The next step is to determine friction loss in 93 feet of 1" pipe when delivering 5 gallons per minute. Referring again to Table 3 it is noted that the 1" pipe length nearest to 93 is 123,

and requires 4 feet of head to deliver 5 gallons per minute. The solution for friction head in 93 feet of 1" pipe is then:

Let X equal the friction head to be found

Thence X is to 93 as 4 is to 123

or $123X = 372$

or $X = \frac{372}{123} = 3.02$ feet friction head in 93 feet of 1" pipe.

Total lift then is 3.02 + 18 feet vertical lift = 21.02 ft.

This total lift is within the pump limits when the installation is new. It is quite possible however that the formation of rust, or the depositing of minerals within a few years may reduce the interior diameter of the pipe, thus creating additional friction losses which might overload the pump.

There is also the possibility of leaks occurring in the pipe joints of long suction lines which would permit entrance of air to the line, and result in inefficient pump operation.

It is evident therefore that while it is possible to pull water for a considerable distance, a more satifactory installation may be made by reducing the length of suction lines and utilizing pressure from the discharge side of the pump to distribute the water.

The most commonly used deep well pump for farmstead water supplies is a combination of a geared deep well pumping head, drop pipe with submerged cylinder, and pump rod, powered with electric motor or gasoline engine.

This type of pump must be placed directly over the well and the operation is identical to that of a windmill.

The "jet" or "ejector" pump is a centrifugal type pump with an ejector assembly. These pumps may be used for either shallow or deep well operation. When used for shallow well where the total lift is 22 feet or less, the suction pipe only is necessary. When used for deep well operation, two pipes are necessary and the ejector assembly is placed in the well below the low water level. There being no moving parts below the level of the pump impeller, these pumps may also be off-set from the well at any desired distance within the pump limits.

PRESSURE WATER SYSTEMS

A pressure water system conforming to the type most commonly used on the farm is composed of a shallow or deep well type pump, pressure tank, electric motor, pressure switch, relief valve, and an automatic device for maintaining the proper

amount of air in the pressure tank at all times, together with the necessary piping to connect the pump outlet to the pressure tank.

The operating tank pressures most commonly carried in small pressure water systems range from a high or cut-out pressure of 40 lbs. per square inch, to a low or cut-in pressure of 20 lbs. per square inch. The difference between these pressures is referred to as the pressure differential.

These pressures will be found satisfactory for most farmstead installations.

There may be occasions, however, when the vertical distance between the pressure system and the highest outlet or faucet is equal to or greater than 46 feet, this being the vertical height to which the water may be raised by 20 lbs. or the low cut-in pressure. In such instances it is necessary to change the pressure switch setting so that the starting or cut-in pressure is at least 5 lbs. over that required to deliver water to the highest outlet or faucet. Changes in pressure switch setting should be made only by the pump manufacturer, or by persons familiar with their operation.

The pumping equipment for all wells should be installed in such a manner that the entrance of contaminated materials into the well will be prevented. Hand pumps should be of closed top construction with solid base, adaptable for use with windmill or pump jack as may be required.

Typical pump installations are shown in the attached figures.

HYDRAULIC RAMS

Hydraulic rams utilize the principle of water hammer, and can operate economically and with little maintenance. In instances where a spring must be used to supply water for a building that is located some distance away, a ram may be found practical.

Conditions for successful ram operation are as follows:

1. Not less than 18 inches fall from spring to ram (24 inches or more is preferable).

2. Not more than 30 feet fall from spring to ram (some manufacturers prefer that their rams operate on a maximum of 16 feet fall).

3. Not less than 25 nor more than 250 feet of drive pipe.

4. Flow from spring of at least 1½ gallons per minute.

Before a hydraulic ram is purchased it is necessary that the following data be secured:

1. Flow of water at source in gallons per minute

2. Length of drive pipe

3. Fall from source to ram, measured in feet *

4. Lift from ram to top of storage, measured in feet *

5. Length of delivery pipe

6. Amount of water required

* Fall and lift are always vertical measurements irrespective of length and slope of pipe.

There are many different types and sizes of rams, and it is important that all controlling factors be known before such equipment is purchased. The manufacturers of such equipment can furnish full details regarding the requirements of the respective sizes of rams, and their instructions must be closely followed to insure efficient results. A typical hydraulic ram installation is shown in Figure 19, together with some useful data as to the requirements and capacities for various installations.

WINDMILLS

In selecting a proper windmill for any definite location, the prevailing wind velocity, the size of the wheel, the diameter of the cylinder, and the lift should be given special consideration to avoid overloading and to assure efficient operation. Windmill dealers can help in selecting the appropriate size of windmill. Three times the actual daily water requirements should be used as a basis for determining wheel size to allow for calm periods when the mill will not operate.

It is advisable that windmills be equipped with an auxiliary hand pump for emergency purposes, and an automatic shut-off device should be installed wherever possible. In sections where extended calm periods are common, the installation of a pump jack and motor may be desirable. The pump jack gears should operate in an enclosed dust proof oil bath similar to that of a windmill head, and the stroke must be the same as that of the windmill.

WINDMILL TOWERS

Towers may be built of either wood or steel. The tower should be of sufficient height that the wheel will be ten feet above surrounding trees and buildings. Plans covering the construc-

tion details of wood towers are contained in Figures 13 and 14. The foundation posts of wood towers should be set solidly. If cedar or other durable timber is not available, creosoted posts should be used. Platforms should be of sufficient size and rigidity to hold a man and equipment.

STORAGE TANKS

The elevation and location of the storage tank are of great importance as they govern the pressure of the water in the entire distribution system. Proper elevation assures some fire protection which often can be obtained with very little additional expense if thought is given such matters in planning the proposed system.

When pumping with a windmill, the tank should have a storage capacity equal to five times the daily requirement. When a pump jack and motor are installed, the capacity may be reduced to $1\frac{1}{2}$ or 2 times the daily water requirements. Capacities of round tanks are given in Table 2.

Cypress or Redwood is preferable to steel as a material for exposed storage tanks. These woods are longer lived than steel, they are not susceptible to corrosion from minerals in the water, and due to the insulating value of the wood, the water is less subject to temperature changes. A tight cover must be provided for sanitary reasons. Details of a wood cover are shown in Figure 10. Care must be taken when installing wood tanks to see that the bottom of the tank rests firmly on the joists of the tower. No weight should be supported by the rim which extends below the bottom of the tank. Filler screeds or bottom supports of 2" x 2" material may be placed so that the weight is carried by the tank bottom. These screeds should be about 12 inches apart and placed at right angles to the bottom staves.

TANK TOWERS

Tank towers may be constructed of wood, steel, or other materials. The tower should be strong enough to support the storage tank and water for the maximum anticipated installations, and must be well braced to prevent damage from high winds. The height of the tower should be a minimum of 10 feet, and the bottom of the tank should be at least eight feet above the highest outlet in the water line. Towers may be enclosed to form a milk house or wash house. In this case a concrete floor with drain should be provided. Figures 6, 7, 8, and 9 show typical wood towers. For larger wood towers and towers of other types, the Regional Engineer's office should be consulted. Steel towers can be obtained from any reliable dealer.

DISTRIBUTION PIPING

The size of the distribution piping from the storage tank to the

various points of delivery throughout the farmstead is dependent upon the available head (vertical distance in feet between the outlet faucet and a point midway between the bottom and top of the storage tank); the maximum quantity of water in gallons per minute required at any one time; and the length of the pipe for which the determination is to be made.

Table 3 gives the carrying capacities of 1/2 inch to 2½ inch pipes for varying heads and lengths. Loss of head due to the friction of water in pipe has been taken into consideration in preparing the table.

The friction loss caused by placing elbows or valves in a pipe line is equivalent to adding more length, and these equivalents are given at the bottom of the table.

Two examples are given to show the use of the table:

Example 1 -

How much water will be delivered by 150 feet of 3/4 inch pipe if the outlet is 12 feet lower than the inlet (head is 12 feet)? The pipeline contains two 90 degree elbows and one globe valve.

Solution -

From Table 3 the friction loss of each 90-degree elbow is equivalent to six feet of pipe, and of each 3/4-inch globe valve, nine feet of pipe or a total of 21 feet. This added to the 150 feet of pipe gives an equivalent length of 171 feet. 171 feet of 3/4-inch pipe with a 12-foot head will deliver four gallons per minute.

Example 2 -

What size pipe will be required to deliver 10 gallons of water per minute with a head of 16 feet? The pipe line will be 480 feet long and will have two globe valves in it.

Solution -

From inspections of Table 3 it is found that the size will fall somewhere between one inch and two inches. The equivalent length of pipe for two globe valves of this size is 24 feet. This added to the 480 feet of pipe required gives an equivalent pipe line length of 504 feet. From the table, the longest length of one inch pipe that will deliver 10 gallons of water per minute with a 16-foot head is 136 feet. It is therefore necessary to go to the column for 1¼ inch pipe where the desired capacity can be had up to 524 feet of pipe.

Where complicated installations are encountered, pipe manufacturers or the Regional Engineer's office can advise what size pipe should be used. In many instances the intake pipe and the outlet pipe can be combined from the base of the tower to the tank. Figure 22 illustrates this type of construction.

All pipes leading to the house, barn, or stock tanks must be below the frost line to assure protection from freezing.

STOCK TROUGHS

Stock troughs for watering livestock may be constructed of wood, metal, concrete or native stone. Figures 24, 25 and 26 show construction details for three types of troughs. In the construction of tile troughs, it is important that the recess or keyway for the construction joint between the tile and concrete be properly formed as shown on Figure 26. The ability of the tile trough to retain water depends greatly upon the plaster coating, and particular attention should be given to this item. Troughs constructed of native stone require special skill and only workmen accustomed to this particular type of construction should be employed for this work.

All stock troughs should be equipped with a float valve supplied by a pipe large enough to furnish the required quantity of water at all times. The pipe size may be determined from Table 3.

CONCRETE

Concrete is a mixture of cement, water and sand, with broken stone or gravel. Water for concrete should be clean enough to drink. Sand and gravel to be suitable for concrete should be free from clay, loam and vegetable matter. The strength and waterproofness of concrete depend upon the quantity of water and cement in their relation to the quantity of sand and broken stone or gravel. The use of too much water gives a thin soupy mixture and results in weak unsatisfactory concrete. Table 4 shows ratios of water, sand and gravel per sack of cement that will generally result in good concrete.

Portland Cement Association bulletins describing concrete and its uses may be obtained through local dealers.

NATIVE STONE MASONRY

In instances where a multiple purpose storage tank tower is desired, such as an enclosed tower that will further serve as a milk or bath house, the unit may be constructed of native stone masonry. It is usually found that the desire for this type of construction is pronounced in vicinities where native stone is abundant and can be secured at no material cost to the farmer, thereby bringing the cost of the installation within

an economic limit of construction. The storage tank may also be constructed of native stone masonry provided that proper sanitary measures such as a cover, etc. are provided.

Workmen skilled in the craft of masonry construction should be employed for all installations of masonry type in order that a workmanlike and attractive unit will result.

The stone should be native stone and should be clean, hard, and of a type known to be durable. The stone should be laid with a cement mortar made of 1 volume of Portland Cement to 3 volumes of damp, loose mortar sand to which may be added not more than 10 lbs. of hydrated lime or lime putty per sack of cement. Sufficient water should be added to the mix to produce, after thorough mixing, a mortar of good working consistency.

In constructing the tower the stone should be laid on a concrete foundation similar to the foundation shown in the manual for "Enclosed Water Tower", Figure 6. The foundation should be checked to see that it is level and straight and chalk lines stretched along the outside of the walls to serve as guide lines in building the corners. Corners should be built 2 or 3 courses high, then chalk line stretched between corners along the outside faces to serve as guides in laying the walls. A good bed of mortar should be placed on the foundation and the stone carefully pressed into the mortar with the outer edge touching the chalk or guide line. Vertical joints should average about 1/4 to 3/8" in thickness with horizontal or bed joints not more than 1/2 inch thick. Walls and corners should be continuously checked for vertical or plumb with plumb line or spirit level.

Windows and door frames are readily built into the wall. They should be temporarily braced into place before the walls on either side are built, care being taken that top of window or door frame is placed at the exact course height where lintels are to be installed. After the walls are brought up on the sides of the windows and door frames the concrete lintels are set in place. To add to the attractiveness of the masonry both vertical and horizontal joints should be tooled.

The floor and roof should be concrete with minimum dimensions and reinforcement as follows based on an outside tower dimension of 8 feet and wood or metal storage tank of not to exceed 56 Bbls. capacity. For stone storage tank not to exceed 30 Bbls. capacity and a minimum of 6' inside diameter:

	Thickness or Slab Depth	Steel Reinforcing
Roof	6"	1/2" ∅ Bars 6" Spacings - Horizontal 3/8" ∅ Bars 12" Spacings - Transverse
Floor	4"	Welded Wire Fabric or heavy gauge hog wire

Lintels are precast concrete blocks placed above door and window openings to carry the stone course across the opening. Lintels should be the height and width of a stone course but not less than 6" in height. The length is determined by the width of the opening plus a minimum 8 inch bearing on each side of the opening. Lintels should be reinforced with two 3/8" ∅ reinforcing bars placed in the concrete 2" up from the bottom of the lintels with each bar being 2 inches in from the side of the lintel.

Roof slab reinforcement should be placed in the bottom portion of the slab $1\frac{1}{2}$ inches up from the bottom of the slab. Floor reinforcement may be placed in the center of the slab.

Prior to pouring the concrete for roof and floor slabs all piping, drains, etc., should be in place through the slabs or sleeves or openings provided so that same may be installed after the slabs are poured without chipping or drilling the concrete.

Where tanks are constructed of stone or purchased as a manufactured unit without cover, an adequate cover should be provided. A suitable cover for round tanks is illustrated as Figure 10.

GARDEN SUB-IRRIGATION

All soils will not respond equally well to sub-irrigation. The ideal condition is to have a rich, pervious top soil, from 12 to 24 inches deep, that is underlaid by a rather tight subsoil. The water will permeate the top soil and spread to the sides more quickly than it will into the clay subsoil. Deep sandy soil and soils only 2 or 3 feet deep that are underlaid by sand or gravel are not suited to sub-irrigation, and extremely tight "gumbo" soils will seldom give satisfactory results.

The tile are laid in level trenches and placed only deep enough to prevent injury to them from plowing or spading.

Depending on the soil type, the tile lines are usually spaced from 3 to 5 feet apart in the same direction as the rows and about 12 inches below the surface of the ground. On sloping ground the tile lines should be laid out along the contours so that the fill over each line will be approximately the same, although each line must be installed at a different level.

One end of each tile line must be provided with a vertical supply pipe extending above ground, and the other end should be sealed with cement mortar. The tile should be laid closely together in the line and the top of each joint should be covered with a strip of heavy asphalt paper.

Costs for 4" commercial drain tile will range upward from 6 cents per foot depending on the distance from the source of supply. Tile may be made on the farm and the general practice is to

provide an inside diameter of approximately 2 inches. This small inside diameter slows the rate of application of water and is also subject to clogging from silt to a much greater extent than 4" tile.

DISINFECTION

Equipment - Whenever a new source of drinking water is developed or an existing source is acquired or repaired, it must be disinfected thoroughly before being put into use. This disinfection should not be confused with the treatment of the water itself. It is done to assure the cleansing of all new equipment and construction, and requires a stronger solution than is used in the sterilization of drinking water.

Disinfection can be done with calcium hypochlorite, better known as chlorinated lime or bleaching powder, containing about 30 per cent available chlorine. A solution of approximately 50 p.p.m. (parts per million) available chlorine should be used to effect complete and proper cleansing of all interior walls of springs, wells, cisterns, and storage tanks. A concentrated solution may be prepared by dissolving fresh chlorinated lime in water in proportions of one ounce (two level tablespoonfuls) of lime to a gallon of water. A proper amount of this solution may then be poured into the well or spring encasement. Table 5 shows the quantity to be used. In order to have the side walls of drilled wells thoroughly washed down, it is advisable to pump the solution out and pour it back into the well one or more times.

The side walls of dug wells, spring encasements, storage tanks and cisterns should be scrubbed with disinfectant made by diluting one pint of the concentrated solution in five gallons of water. A clean, long-handled broom may be used for applying the disinfectant. New pipe and pumps may also be washed with this diluted solution.

Drinking Water - The disinfection of drinking water by home methods should be considered an emergency measure. The purity of water is often suspected before the existence of disease becomes definitely known. Suspision may be created by minor intestinal ailments or by odor or taste of the water. Pending examination by a competent sanitation authority, the householder should boil all water used for drinking and cooking purposes.

County or State Health Authorities will determine the amount and kind of disinfectant for each particular water. These matters are guess work with the average individual. He may guess wrong, and his efforts to disinfect drinking water may lead to a false sense of safety. For these reasons absolute reliance cannot be placed upon home methods of sterilizing water with chemicals.

As a temporary precaution against disease, however, water may

be treated with chlorinated lime as outlined in Table 5. When using this method the concentrated solution of chlorinated lime should be well mixed with the water, which should be fit to drink after five or six hours. The chlorine taste will disappear in a few days.

The foregoing treatment is effective only for the water in the well or cistern at the time the chlorine solution is added. Subsequent water entering the well or cistern is not affected, and may even pollute the treated water.

COLLECTION OF WATER SAMPLES

All farmstead water supplies, either new, existing or repaired, must be tested to determine their safety for drinking purposes. Sterile bottles for the collection of water samples may be obtained from respective State Health Departments, and their instructions for the collection and shipment of water samples must be observed. Water samples sent through the mail must be packed in accordance with U. S. Postal regulations. State Health Departments generally will examine water samples at no cost, provided their instructions for collection have been complied with.

In the collection of water samples, great care should be used to avoid accidental contamination, and the following procedures should be observed:

1. The faucet or pump spout from which the sample is to be collected should be flamed with a blow-torch, paper torch or other flaming device.

2. After flaming, water should be allowed to run freely from the faucet or pump spout for several minutes.

3. To fill the bottle prepared for use by the State Laboratory, unscrew the cap from the bottle and hold it in one hand so that nothing touches the inside of the cap; then hold the bottle in the other hand by the lower half and place under outlet, filling the bottle to the shoulder, and retaining the first water entering the bottle. <u>Do not rinse out the bottle</u>. Screw the cap down so it fits tight, but do not apply pressure which will split the cap.

4. Fill in the card which accompanies the bottle, giving all requested information in accordance with the directions thereon.

5. Pack the filled bottle, (including the card) in accordance with Postal Regulations and mail immediately to the State Laboratory. Water samples received by the State Laboratory later than 72 hours after collection will not be analyzed.

6. Do not collect water samples from a water supply that has been disinfected until all trace of chlorine has disappeared.

ESTIMATING SCHEDULE AND GUIDE

The Estimating Schedule and Guide for Domestic and Stock Water Supply Installation, a sample copy of which is bound herewith, has been prepared to assist the technician in the preparation of the cost estimate for a facility, and is intended for field use only. When the completed estimate has been transferred to the Form 656A, the pencil copy of the estimating schedule and guide which has been prepared in the field, may then be filed in the county office for future reference, or turned over to the co-operator as a check list for the purchase of materials and equipment.

Additional copies may be obtained upon request from the Regional Engineer.

ESTIMATE AND COST REPORT - FORM 656A

The completed sample copy of the Estimate & Cost Report bound herewith shows both the estimated and the actual cost of the facility. The amounts under "Actual" are inserted as the work progresses and may vary from the amounts previously estimated.

EXTRA COPIES OF DRAWINGS

Copies of drawings contained within this manual may be obtained for use by contractors or farmers during construction of a Facility, upon application to the Regional Engineer.

TABLE 1

	Average Gallons Per Day
For each member of a family for all purposes	35
For each horse, mule or head of beef cattle	15
For each dairy cow	30
For each sheep or goat	2
For each mature hog	3
For each shoat	1.5
For each 100 chickens	3
For each 100 turkeys	6
*For each 1000 square feet of garden	250

*The estimate for a garden is based on the requirement of 1 foot of water per month for the months of June, July and August. Since this constitutes an extended period, the well must be designed to supply the daily requirements unless an excessively large storage is available.

TABLE 2

NUMBER OF GALLONS IN ROUND CISTERNS AND TANKS								
DEPTH IN FEET	DIAMETER IN FEET							
	5	6	7	8	9	10	11	12
2	294	423	576	752	952	1175	1422	1692
3	441	643	864	1128	1428	1762	2133	2538
4	587	846	1151	1504	1903	2350	2843	3384
5	734	1057	1439	1880	2379	2947	3554	4230
6	881	1269	1727	2256	2855	3525	4265	5076
7	1028	1480	2015	2632	3331	4113	4976	5922
8	1175	1692	2304	3008	3807	4700	5687	6768
9	1322	1904	2591	3384	4283	5288	6398	7614
10	1469	2115	2879	3760	4759	5875	7109	8460

TABLE 3

MAXIMUM ALLOWABLE LENGTH OF PIPE IN FEET FOR GALLONS PER MINUTE FLOW

Head	3 Gal per Min			4 Gallons per Minute					5 Gallons per Minute					10 Gallons per Minute						
in Feet	½" Pipe	3/4" Pipe	1" Pipe	½" Pipe	3/4" Pipe	1" Pipe	1¼" Pipe	1½" Pipe	½" Pipe	3/4" Pipe	1" Pipe	1¼" Pipe	1½" Pipe	½" Pipe	3/4" Pipe	1" Pipe	1¼" Pipe	1½" Pipe	2" Pipe	2½" Pipe
2	12	48	158	6	28	93	350	769	4	18	61	238	512	1	4	17	65	139	400	1176
4	25	97	317	14	57	186	701	1538	9	38	123	476	1025	2	9	34	131	279	800	2352
6	37	146	476	22	85	280	1052	2307	14	57	184	714	1438	3	14	51	196	419	1200	3529
8	50	195	634	29	114	373	1403	3076	19	76	246	952	2051	4	20	68	262	559	1600	4705
10	63	243	793	37	142	467	1754	3846	24	95	307	1190	2564	6	25	85	327	699	2000	5882
12	75	292	952	44	171	560	2105	4615	29	114	369	1428	3076	7	31	102	393	839	2400	7058
14	88	341	1111	51	200	654	2456	5384	34	133	430	1666	3589	8	36	119	459	979	2800	8235
16	101	390	1269	59	228	747	2807	6153	39	152	492	1904	4102	10	42	136	524	1118	3200	9411
18	113	439	1428	66	257	841	3157	6923	44	171	553	2142	4615	11	47	153	590	1258	3600	10588
20	126	487	1587	74	285	934	3508	7692	49	190	615	2380	5128	13	52	170	655	1398	4000	11764
22	139	536	1746	81	314	1028	3859	8461	53	209	676	2619	5641	14	57	188	721	1538	4400	12941
24	151	585	1904	88	342	1121	4210	9230	58	228	738	2857	6153	15	63	205	786	1678	4800	14117
26	164	634	2063	96	371	1214	4561	9999	63	247	799	3095	6666	16	68	222	852	1818	5200	15294
28	177	682	2222	103	400	1308	4912	10769	68	266	861	3333	7179	18	73	239	918	1958	5600	16470
30	189	731	2380	110	428	1401	5263	11538	73	285	923	3571	7692	19	78	256	983	2097	6000	17647
32	202	780	2539	118	457	1495	5614	12307	78	304	984	3809	8205	21	84	273	1049	2237	6400	18823
34	215	829	2698	125	485	1588	5964	13076	82	323	1046	4047	8717	23	89	290	1114	2377	6800	19999
36	227	878	2857	133	514	1682	6315	13846	87	342	1107	4285	9230	24	94	307	1180	2517	7200	21176
40	253	975	3174	148	571	1869	7017	15384	97	380	1230	4761	10256	27	105	341	1311	2797	8000	23529
45	284	1097	3571	166	642	2102	7894	17307	109	428	1384	5357	11538	30	118	384	1475	3146	9000	26470
50	316	1219	3968	185	714	2336	8771	19230	121	476	1538	5952	12820	34	131	427	1639	3496	10000	29411

Size of pipe in inches	½	3/4	1	1¼ to 2	2½
Feet of pipe to be subtracted from above table for each 90 degree elbow or tee	5	6	6	8	11
Feet of pipe to be subtracted from above table for each globe valve	8	9	9	12	17

TABLE 4
RECOMMENDED MIXTURES FOR SEVERAL CLASSES OF CONSTRUCTION

	Gallons of Water Per Sack of Cement			Sand and Gravel Per Sack of Cement		Approximate Amounts Of Materials Required Per Cubic Yard Of Concrete			Largest Size of Gravel
	Very Wet Sand	Average Sand	Dust Dry Sand	Cubic Feet Of Sand	Cubic Feet Of Gravel	Sacks of Cement	Cubic Yards of Sand	Cubic Yards of Gravel	
Most farm construction such as floors, steps, basement walls, walks, yard pavements, silos, grain bins, and cisterns.	4	5	$5\frac{1}{2}$	2-1/4	3	$6\frac{1}{4}$	3/4	4/5	$1\frac{1}{2}$"
Concrete in thick sections and not subject to freezing. Thick footings, thick foundations, retaining walls, engine bases.	$4\frac{1}{2}$	$5\frac{1}{2}$	6	2-3/4	4	5	3/4	4/5	$1\frac{1}{2}$"
Thin reinforced concrete such as milk-cooling tanks, fence posts, thin floors, most uses where concrete is two to four inches thick.	4	5	$5\frac{1}{2}$	2-1/4	$2\frac{1}{2}$	$6\frac{1}{2}$	3/4	4/5	3/4"
Very thin concrete such as top course of two course pavements and floors, concrete furniture and most cases where concrete is one to two inches thick.	3	4	$4\frac{1}{2}$	1-3/4	$2\frac{1}{4}$	8	3/4	4/5	3/8"

TABLE 5
PURIFICATION BY CHLORINATED LIME

Diameter of Well, Tank, or Cistern	Gallons of Water Per Vertical Ft.	Amount of Concentrated Solution* to be Added per Vertical Foot of Water: For Sterilizing Equipment	For Disinfecting Drinking Water
2"	0.16	1 tablespoonful	1/10 teaspoonful
4"	0.65	4 tablespoonfuls	1/2 teaspoonful
6"	1.47	9 tablespoonfuls	1 teaspoonful
8"	2.61	1/2 pint	2 teaspoonfuls
10"	4.08	3/4 pint	1 tablespoonful
12"	5.88	1 pint	1½ tablespoonfuls
2'	23.50	4½ pints	6 tablespoonfuls
3'	52.88	4½ quarts	13½ tablespoonfuls
4'	94.03	8½ quarts	24½ tablespoonfuls
5'	146.84	3½ gallons	1¼ pints
6'	211.47	4-3/4 gallons	1-3/4 pints
7'	287.85	6½ gallons	2¼ pints
8'	376.05	8½ gallons	1½ quarts
9'	475.91	11 gallons	2 quarts
10'	587.52	13½ gallons	2½ quarts
11'	710.87	15 gallons	2-3/4 quarts
12'	846.05	19 gallons	3½ quarts

* Concentrated solution prepared by dissolving one ounce (two level tablespoonfuls) of chlorinated lime in one gallon of water.

3 teaspoonfuls = 1 tablespoonful   2 pints = 1 quart
32 tablespoonfuls = 1 pint   4 quarts = 1 gallon

FARM SECURITY ADMINISTRATION
WATER FACILITIES PROGRAM

REGION VIII
DALLAS, TEXAS

ESTIMATING SCHEDULE & GUIDE
FOR DOMESTIC AND STOCK WATER SUPPLY INSTALLATION

DAILY WATER REQUIREMENTS

1. ________ persons @ 35 gallons per day............ ____________ gallons.

2. ________ beef cattle @ 15 gallons per day......... ____________ gallons.

3. ________ dairy cows @ 30 gallons per day......... ____________ gallons.

4. ________ horses and mules @ 15 gallons per day.. ____________ gallons.

5. ________ sheep and goats @ 2 gallons per day.... ____________ gallons.

6. ________ mature hogs @ 3 gallons per day........ ____________ gallons.

7. ________ shoats @ 1.5 gallons per day............ ____________ gallons.

8. ________ chickens @ 3 gallons per 100 per day... ____________ gallons.

9. ________ turkeys @ 6 gallons per 100 per day.... ____________ gallons.

10. ________ square feet of garden @ 250 gallons per 1000 square feet per day................ ____________ gallons.

11. ________ gallons per day.. ____________ gallons.

Total Water Requirements in Gallons Per Day.... ____________

DRILLED WELL

1. Size of hole______inches Depth of hole_______feet

2. Size of casing____inches Length of Casing____feet

3. Cost per foot for drilling and casing $_________

4. ________Cu. Yds. Concrete @ $_______per Cu. Yd. $______

Total Cost of Cased Well with Top Seal and Slab..........$________

DUG WELL

1. Diameter________feet.

2. Depth___________feet.

3. _______Cubic Yards Excavation @ _____per cu. yd... $__________

4. _______Bricks @ $___________ per 1000........... $__________

5. _______Cu. Yds. Mortar @ $_____per cu. yd......... $__________

6. _______Cu. Yds. Concrete @ $_____ per cu. yd..... $__________

7. _______Feet of 3/8" ∅ steel bars @ $_____per ft... $__________

8. _______Hours of Skilled Labor @ $________per hr... $__________

9. _______ @ $________ $__________

Total Cost of Dug Well.................................. $__________

CYLINDER

1. Size________inches Stroke________inches Cost $__________

DROP PIPE (Galvanized, Plugged and Reamed)

1. Size _______inches (larger than cylinder)

2. Length______feet

3. Cost per foot $__________ Total Cost of Pipe $_______________

PUMP ROD

1. Size ________inches Material_______________

2. Length________feet

3. Cost per foot $_______ Total Cost of Pump Rod $_____________

HAND PUMP

1. Type ______________________________

2. Make ______________________________

Cost $ ________________

POWER PUMP

1. Type ______________________________

2. Make ______________________________

Cost $ ________________

POWER PRESSURE SYSTEM

1. Type ____________________ __________

2. Make ______________________________

3. Capacity __________ gallons per hour

Cost $ ________________

PUMP HOUSE (Power Pump or Pressure System)

1. Size ______________________ Material ________________

Cost $ ________________

WINDMILL

1. Size ___________ feet Cost $ ________________

WINDMILL TOWER

1. Height ________ feet Material __________________

Cost $ ________________

ELEVATED STORAGE TANK WITH COVER

1. Capacity ________________ gallons. Material ______________

Cost $ ________________

STORAGE TANK TOWER

1. Height ________ feet Material ____________________

2. Enclosed: Yes ______ No ___________

3. Milk Box: Yes _______ No ___________

Cost $ ________________

STOCK TANK WITH FLOAT VALVE

1. Capacity________gallons Material________________

Cost $________________

PIPE

1. Size______inches. Length______feet. Cost $__________per ft.

Cost $________________

2. Size______inches. Length______feet. Cost $__________per ft.

Cost $________________

3. Size______inches. Length______feet. Cost $__________per ft.

Cost $________________

VALVES AND FITTINGS

1. Gate Valves, Size_____Number_______Cost $___________each.

Cost $________________

2. Check Valves, Size____Number_______Cost $___________each.

Cost $________________

3. Stop & drain valves, Size______Number______Cost $_______each.

Cost $________________

4. Pipe fittings & Hose faucets, one lot Cost $_______________

SKILLED LABOR ESTIMATE

1. Man hours to construct tank tower......____________
2. Man hours to erect windmill & tower and install drop pipe, cylinder and rod....____________
3. Man hours to install power pump........____________
4. Man hours to install pressure system...____________
5. Man hours to construct pump house......____________

Total Man Hours.............____________
Rate Per Hour...............$____________

Total Skilled Labor Cost................. $____________

FARMER LABOR ESTIMATE

1. Man hours to mix and install concrete..____________
2. Man hours to install all pipe..........____________
3. Man hours to install storage tank......____________
4. Man hours to construct stock tank......____________
5. ____________
6. ____________

Total Man Hours Contributed.____________
Rate per Hour...............$____________
Total Farmer Labor Contribution........... $____________

TRANSPORTATION

1. _______ ton truck _______ miles @ $_______ per mile... $____________

COST RECAPITULATION	FSA		FARMER
Skilled Labor	$________		
Unskilled Labor	$________		
Farmer Labor Contribution			$________
Materials and Equipment	$________		
Contingencies 10%	$________		
Transportation			$________
Total FSA	$________	Farmer	$________

TOTAL FSA..............................$____________
TOTAL FARMER...........................$____________
Estimated Cost of Complete Installation...$____________

S. C. S.-656A

UNITED STATES DEPARTMENT OF AGRICULTURE

~~SOIL CONSERVATION SERVICE~~

FARM SECURITY ADMINISTRATION

ESTIMATE AND COST REPORT

State TEXAS

Name (~~area or~~ county) BLANK

W. F.—Area ☑ or demonstration ☐ (check one).

Type—Individual ☑ or group ☐ (check one).

Farm plan or group plans—No.

Installed by ~~S. C. S.~~ ☐ or farmer(s) ☑ (check one).

Date JULY 20, 19 45 Work order No.

Number families involved 1

Name of farmer or group JOHN DOE

Acres in farm(s) 300

Technician ROBERT SMITH, FSA SUPERVISOR

Description of work DRILL, CASE AND DEVELOP WELL; INSTALL WINDMILL, 56 BBL. STORAGE TANK AND TOWER, PUMP, STOCK TROUGH, AND DISTRIBUTION PIPING.

ESTIMATED AND ACTUAL FIGURES ON WORK

ITEM	UNIT	ESTIMATED					ACTUAL				
		Unit value	~~S. C. S.~~ FSA		Farmer(s)		Unit cost	~~S. C. S.~~ FSA		Farmer(s)	
			Quantity	Cost	Quantity	Cost		Quantity	Cost	Quantity	Cost
(a) Labor—supervisory											
Other COMMON	HR.	.50			60	30.00				68	34.00
DRILL & CASE WELL (6")	FT.	1.90	110	209.00			1.90	108	205.20		
2" GALV. DROP PIPE	FT.	.32	100	32.00			.32	98	31.36		
(b) ~~Material~~ 1-1/8" PUMP ROD	FT.	.18	100	18.00			.18	98	17.64		
1-7/8" X 24" CYLINDER	EA.		1	16.00				1	16.00		
HAND PUMP (WINDMILL TYPE)	EA.		1	16.00				1	16.00		
8 FT. WINDMILL & 30 FT. STEEL TOWER IN PLACE	EA.		1	135.00				1	135.00		
56 BBL. STEEL TANK AND 10 FT. TOWER (IN PLACE)	EA.		1	189.00				1	189.00		
(c) ~~Equipment~~ STOCK TROUGH	L.S.		1	35.00				1	35.00		
1¼" PIPE	FT.	.18	150	27.00			.18	165	29.70		
1" PIPE	FT.	.12	100	12.00			.12	100	12.00		
VALVES & FITTINGS	LOT		1	10.00				1	14.00		
(d) Transportation 1 TON TRUCK	MI.	.10			65	6.50				65	6.50
INCIDENTALS				10.00							
TOTAL,				709.00		36.50			700.90		40.50

Work units ☐ ☐ ☐ ☐

Estimated: Total cost 745.50; Amount of repayment 709.00

Actual: Total cost 741.40; Amount of repayment 709.00

I HEREBY CERTIFY that installation of the above-described facility(ies) has been completed in accordance with the specification in the Water Facilities plan section of Farm Plan—Group Plans No.

Approved: /s/ ROBERT SMITH Title FSA SUPERVISOR

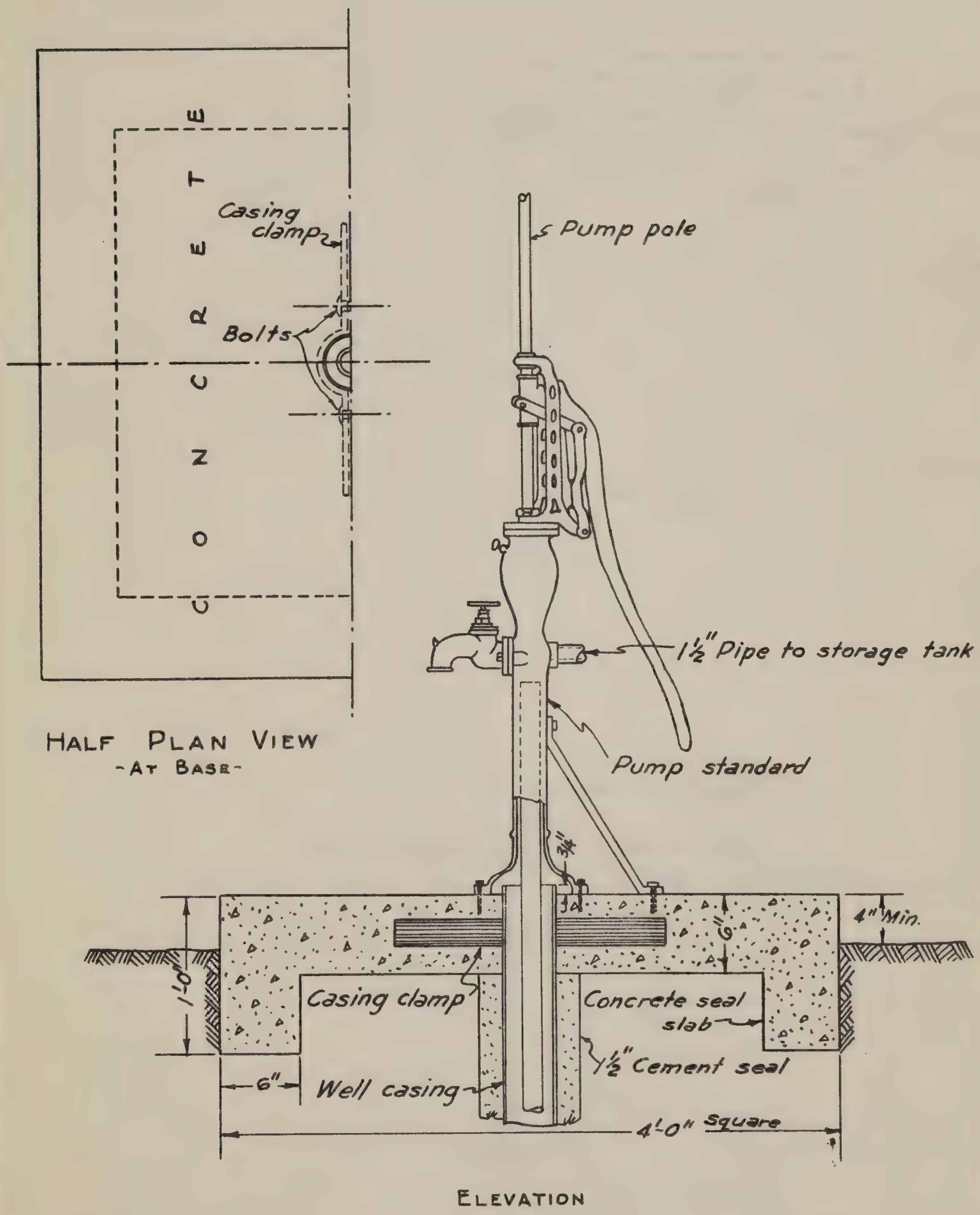
Date installation started AUG. 6, 19 45 Date installation completed and certified to F. S. A. AUG. 29, 19 45

Approved as to date of completion.

/s/ JOHN DOE

(Farmer(s) signature)

8—12982



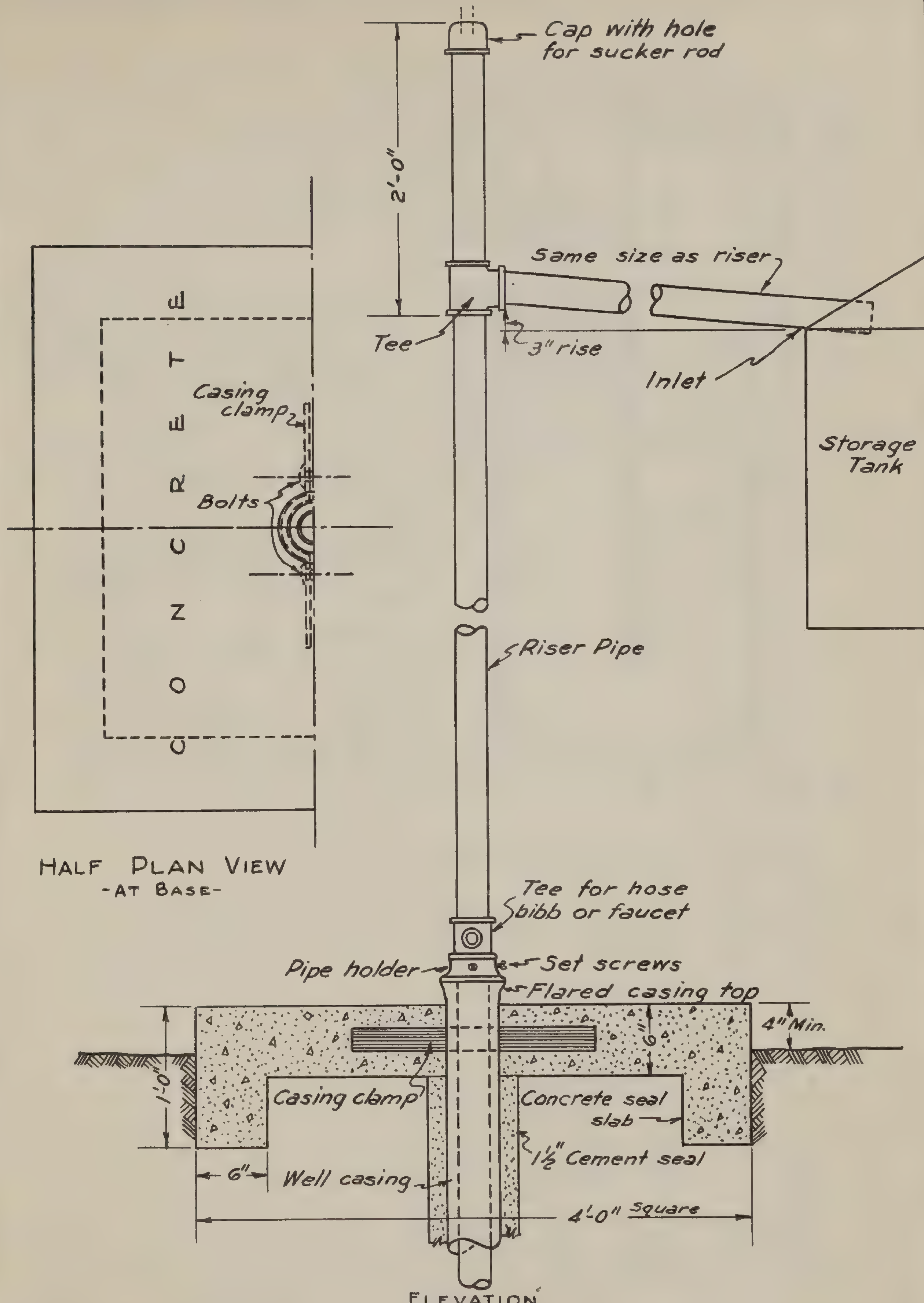
U.S. DEPARTMENT OF AGRICULTURE - FARM SECURITY ADMINISTRATION

WELL TOP DETAIL

(Hand pump)

REGION 8 DALLAS TEXAS

FIG. 1



U·S· DEPARTMENT OF AGRICULTURE — FARM SECURITY ADMINISTRATION

WELL TOP DETAIL
(splasher system)

REGION 8 — DALLAS TEXAS

FIG. 2

NOTE:

Curbing to be brick, concrete pipe or clay tile
The concrete seal should be added to a minimum depth of 10'-0"

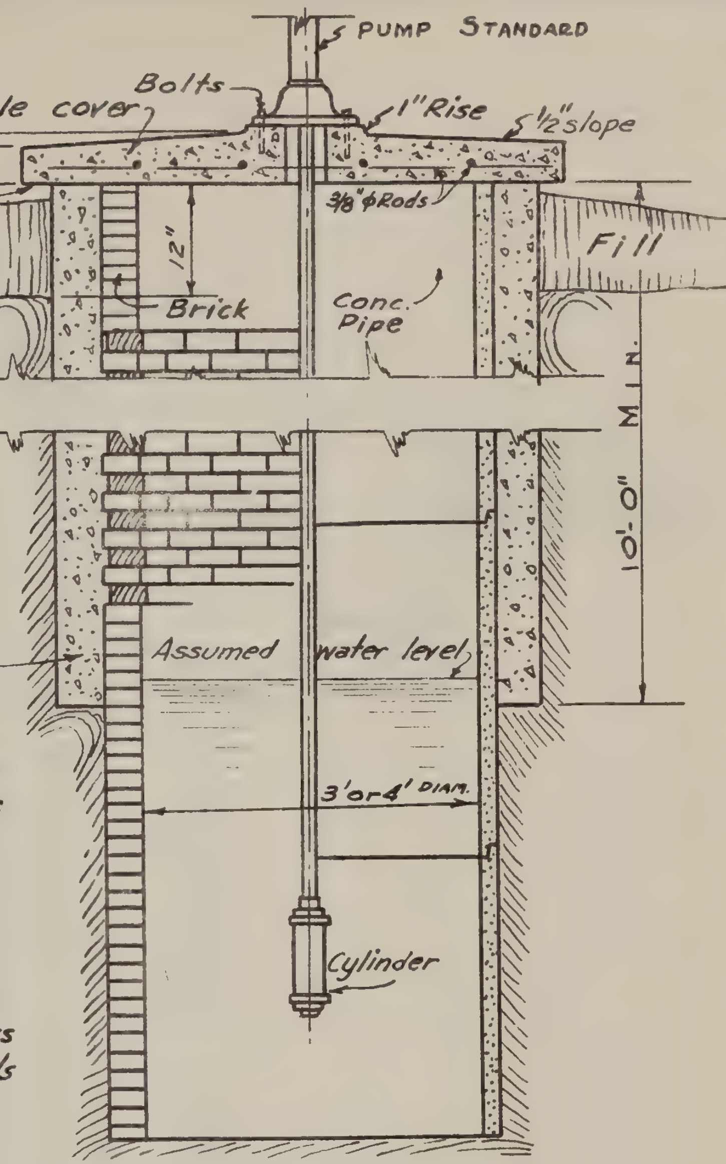
Minimum thickness of seal - 5"

BILL OF MATERIALS - 3' DIAM. WELL

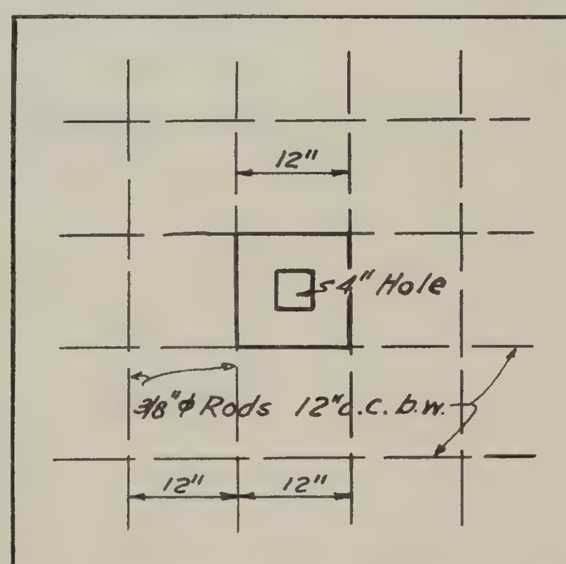
Cement	11.5 sacks
Sand & Stone	2.3 Cu. Yds
Reinforcing steel	34'-3/8"ϕ
Brick per foot of depth	69
Mortar " " " "	1.9 Cu. Ft.

BILL OF MATERIALS - 4' DIAM. WELL

Cement	14.5 sacks
Sand & Stone	2.9 Cu. Yds
Reinforcing steel	68'-3/8"ϕ
Brick per foot of depth	92
Mortar " " " "	2.5 Cu. Ft.



VERTICAL SEC.



PLAN OF TOP

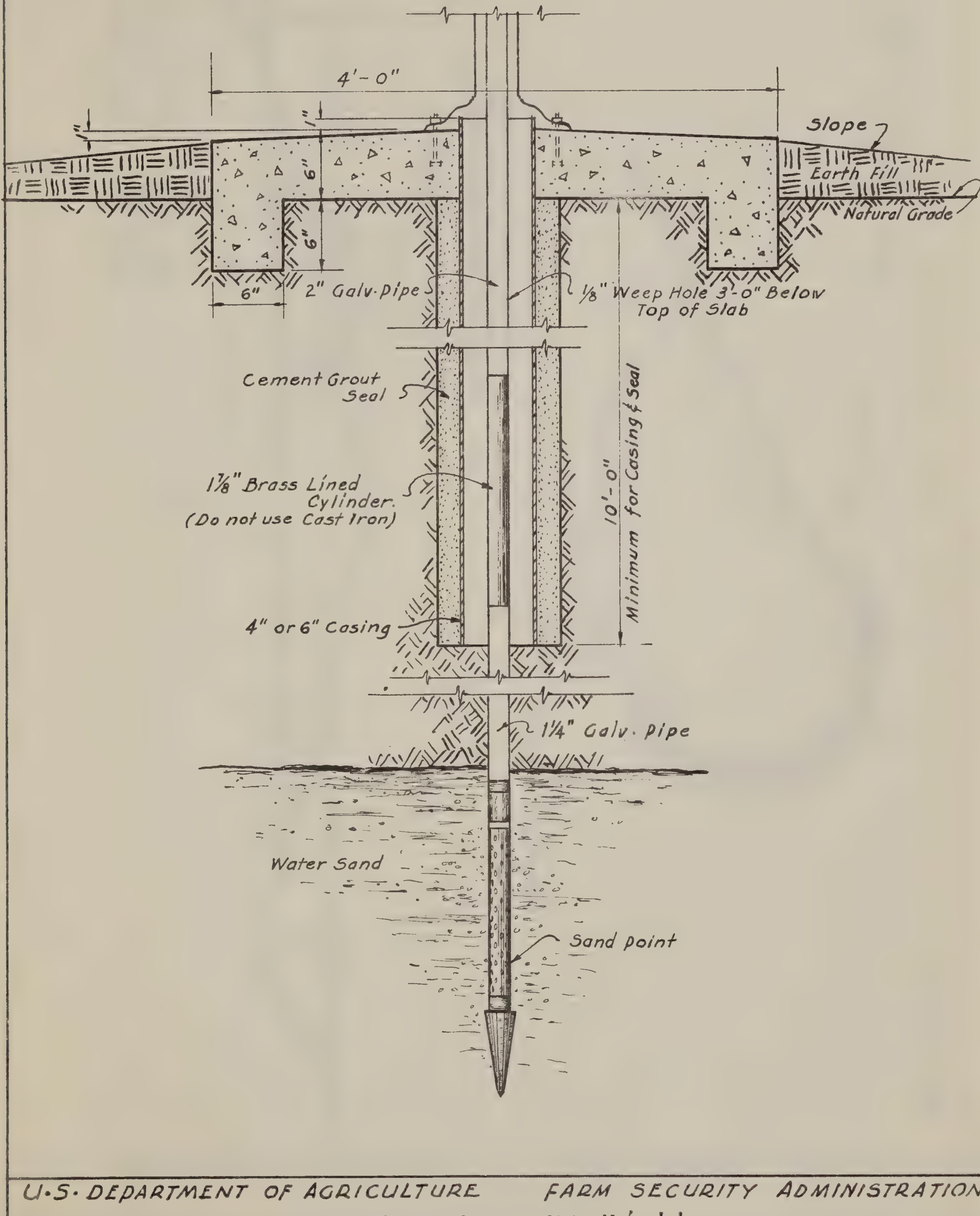
SCALE: 1/2" = 1'-0"

US DEPARTMENT OF AGRICULTURE — FARM SECURITY ADMINISTRATION

DUG WELL

REGION 8 — DALLAS TEXAS

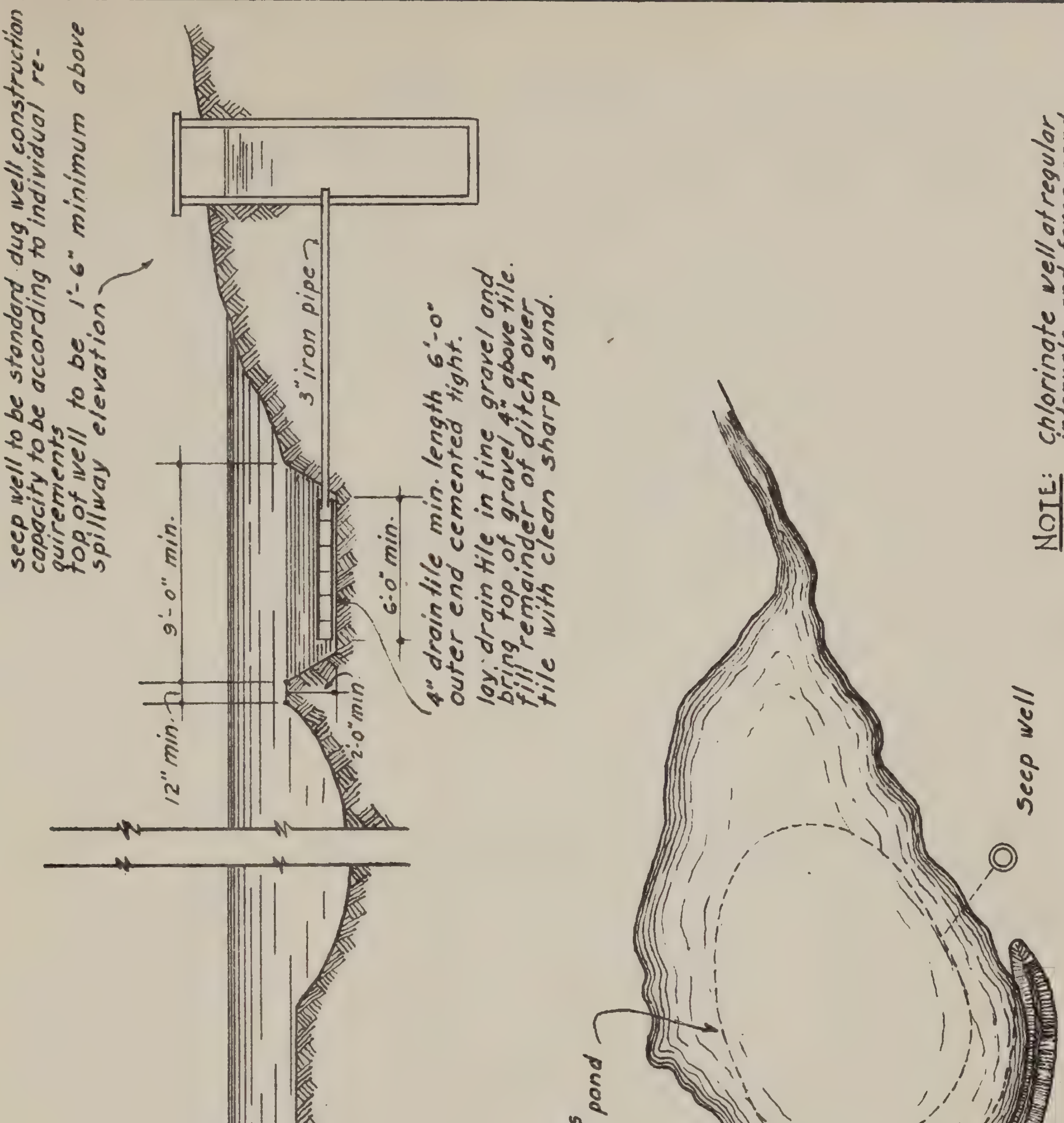
FIG. 3



U.S. DEPARTMENT OF AGRICULTURE FARM SECURITY ADMINISTRATION

REGION 8 SAND POINT WELL DALLAS TEXAS

FIG. 4



NOTE: Chlorinate well at regular intervals and fence pond area against stock.

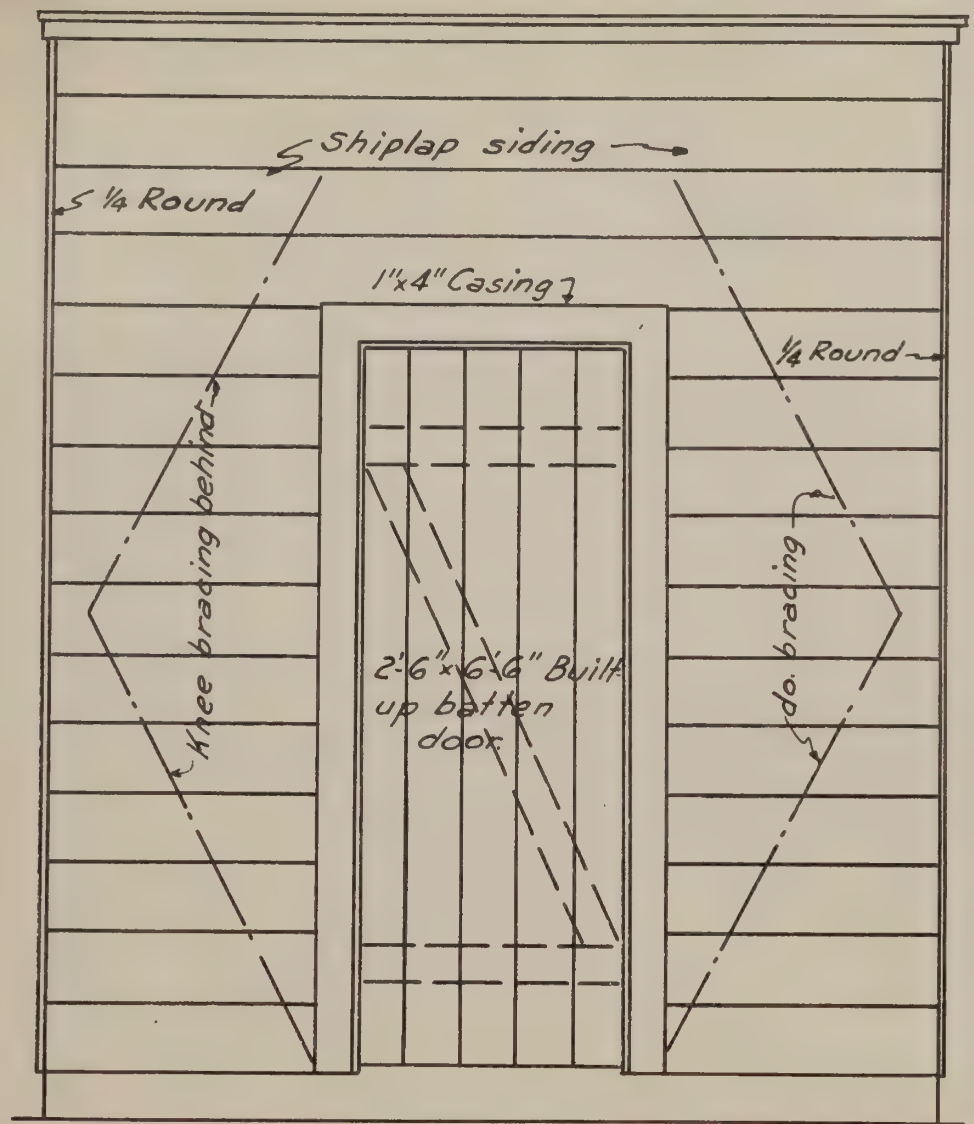
NOT TO SCALE

U. S. DEPARTMENT OF AGRICULTURE — FARM SECURITY ADMINISTRATION

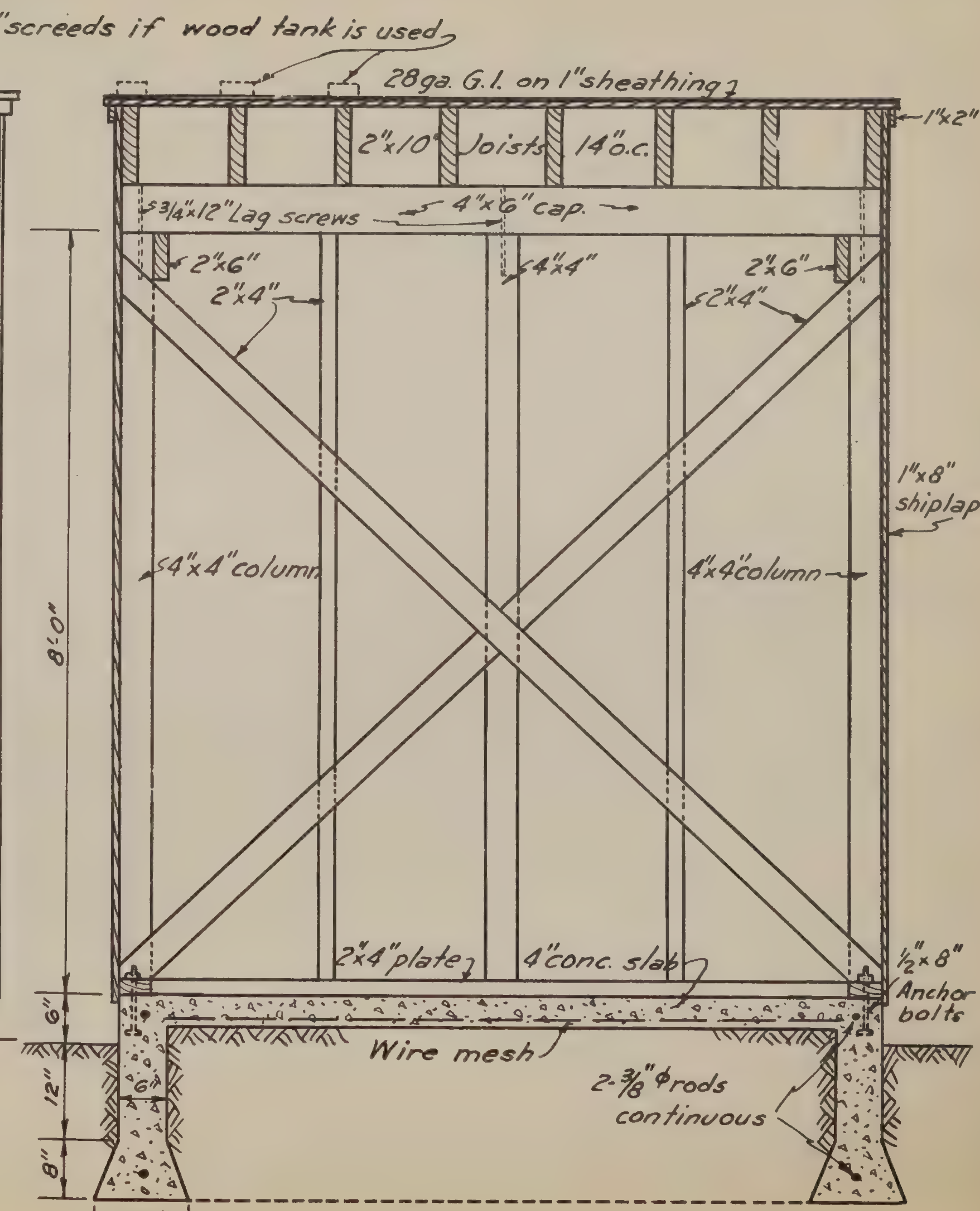
SEEP WELL

REGION 8 — DALLAS TEXAS

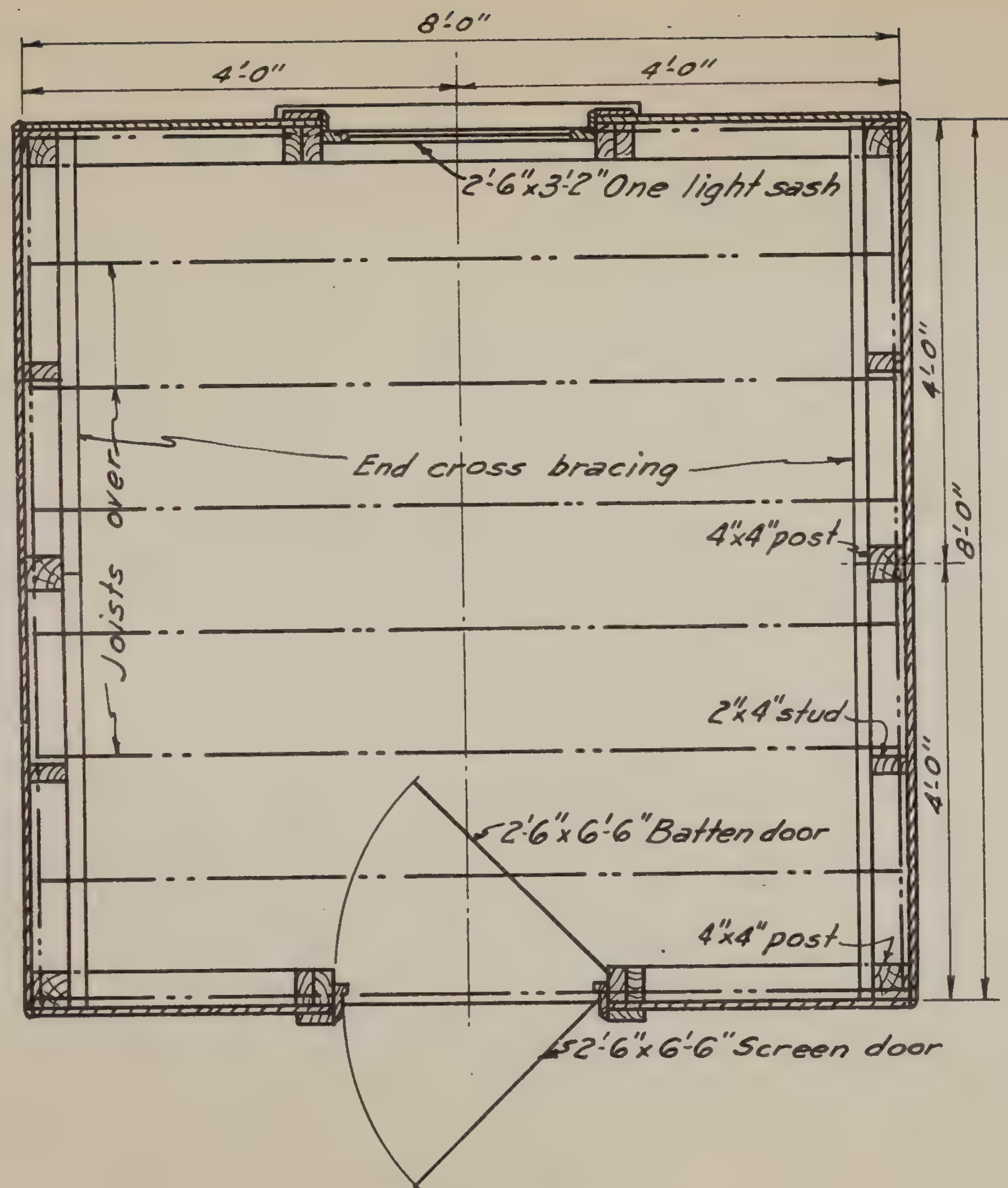
FIG. 5



ELEVATION



SECTION



PLAN
SCALE: 1/2"=1'-0"

BILL OF MATERIALS

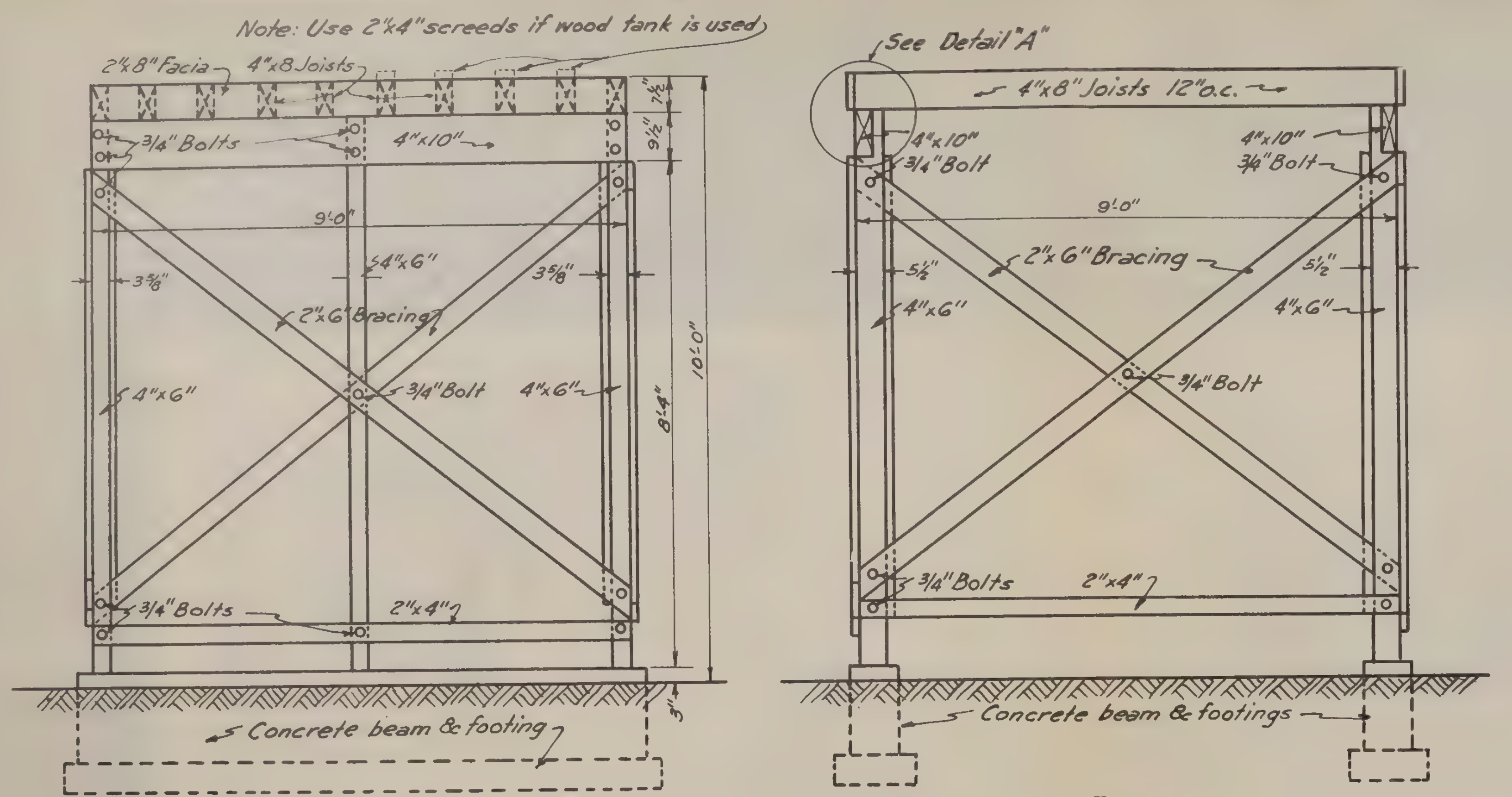
QUANTITY	ITEM
6	4"x4"-8'-0" Columns
12	2"x4"-8'-0" Studs
4	2"x4"-10'-0" Cross braces
8	2"x4"-5'-0" Knee braces
4	2"x4"-3'-0" Door & window headers
4	2"x4"-8'-0" Plates
1	2"x6"-3'-6" Window sill
10	2"x10"-8'-0" Joists
2	4"x6"-8'-0" Caps
100 L.F.	1"x2" Facia, door & window stops
30 L.F.	1"x4" Exterior door & window casing
32 L.F.	3/4" Quarter round
256 S.F.	1"x8" Shiplap siding
68 S.F.	1" Roof sheathing
68 S.F.	28 Ga. galvanized iron roofing
64 L.F.	3/8"φ Reinforcing steel
49 S.F.	6"x6" Reinforcing wire mesh
8	1/2"x8" Anchor bolts
6	3/4"x12" Lag screws
1	2'-6"x6'-6" Builtup batten door
1	" " Screen door
1	2'-6"x3'-2"x1 3/8" 1 Lt. window sash (hinged)
1	" " Window screen
	Nails, screws & hinges

U.S. DEPARTMENT OF AGRICULTURE FARM SECURITY ADMINISTRATION

TANK TOWER

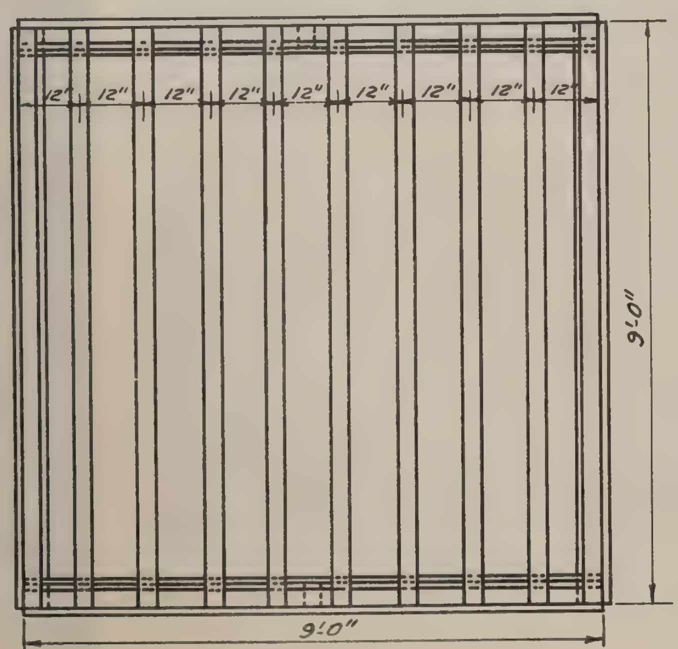
REGION 8 (enclosed - 56 bbl. maximum capacity) DALLAS TEXAS

FIG. 6

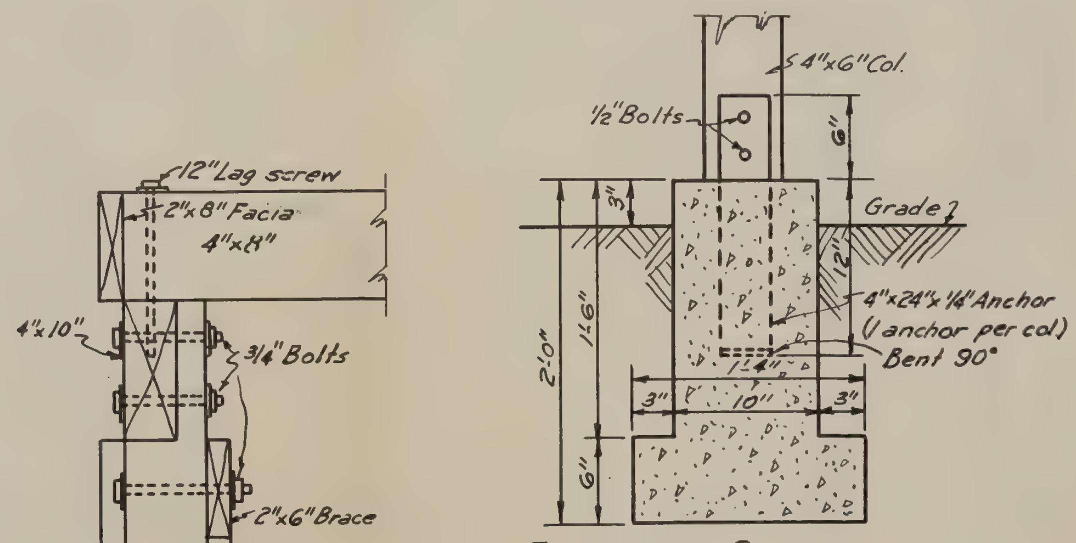


End Elevation

Side Elevation



Plan
SCALE: 3/8"=1'-0"



Detail "A"
SCALE: 1"=1'-0"

Foundation Section
SCALE: 1"=1'-0"

BILL OF MATERIALS

Quantity	Item
6	4"x 6"-9'-1½" Columns
2	4"x10"-9'-0" Caps
10	4"x8"-9'-0" Joists
8	2"x6"-12'-0" Diagonal braces
4	2"x4"-9'-0" Horizontal braces
42	¾"φ Bolts
84	2" Sq. washers
6	4"x24"x¼" Anchor plates
12	½"φ Anchor bolts
12	1½"φ Washers
20	¾"x12" Lag screws
7.5 sks	Cement
0.7 c.y.	Sand
1.1 c.y.	Stone
2	2"x8"-9'-0" Facia

General Notes:

3½ gallons of paint required.

If metal tank is used floor over joists with 2"x6" spaced ½" apart & omit 2"x4" used on top of joists under.

All lumber to be S4S Nº1 Yellow Pine or Fir.

Use 6 gallons of water per sack of cement in mixing concrete.

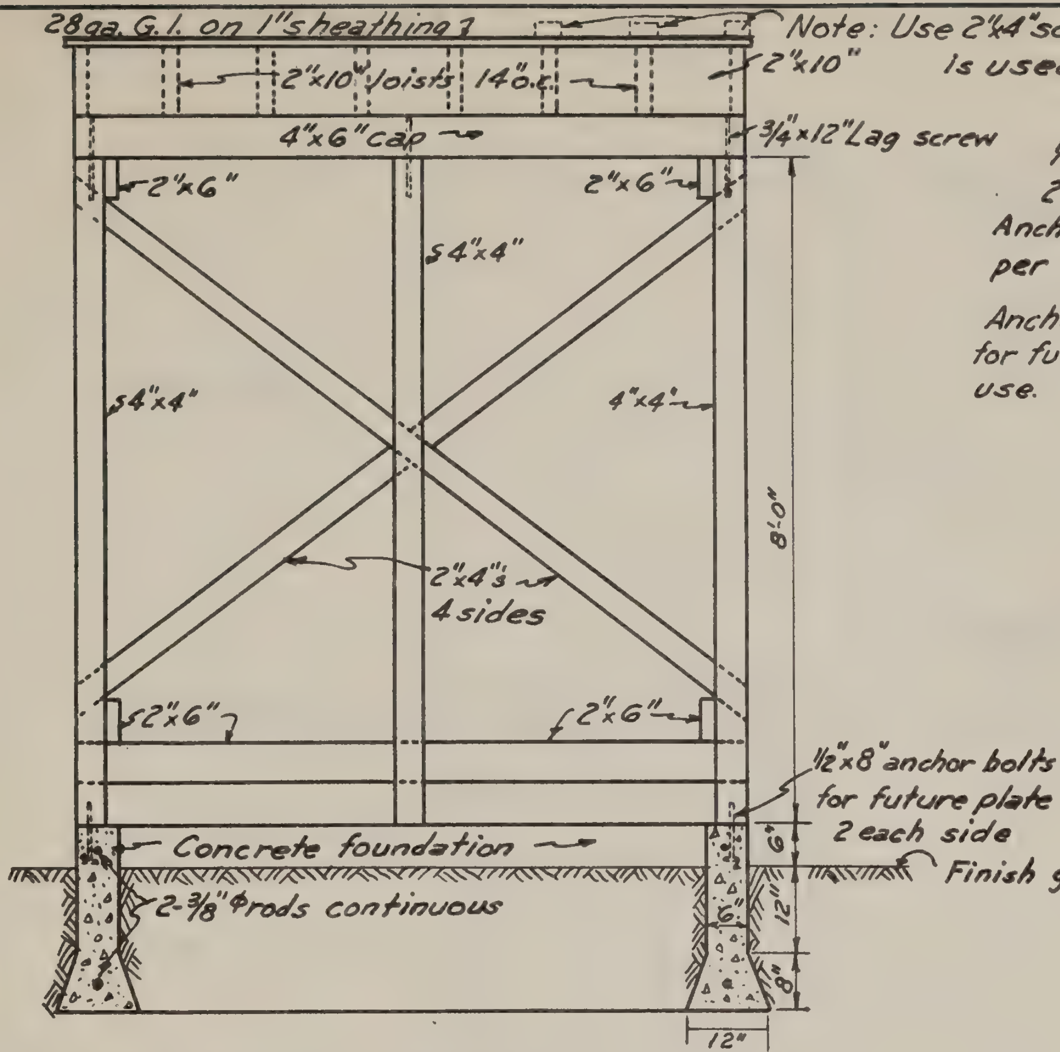
U.S. DEPARTMENT OF AGRICULTURE — FARM SECURITY ADMINISTRATION

TANK TOWER

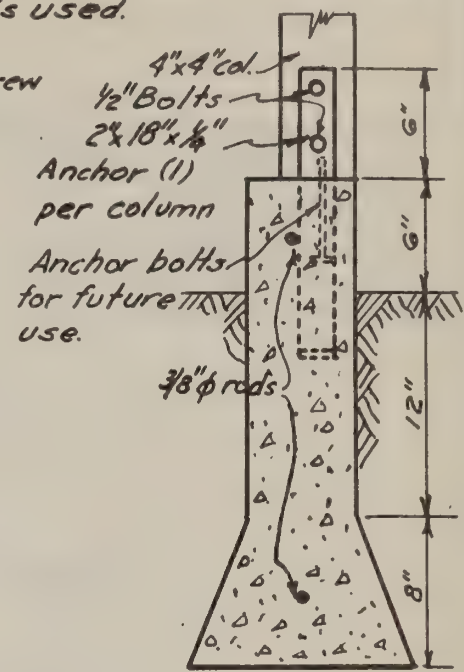
(maximum Capacity 80 bbls.)

REGION 8 — DALLAS TEXAS

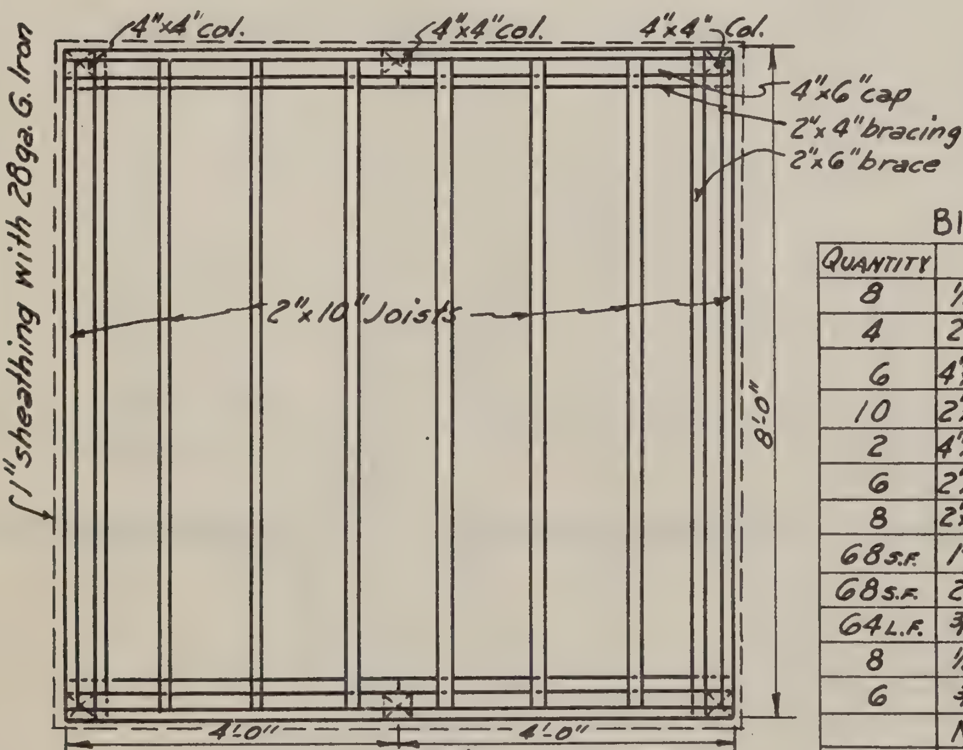
FIG. 7



ELEVATION & FOUNDATION SECTION



ANCHOR DETAIL
SCALE: 1"=1'-0"



PLAN
SCALE: 3/8"=1'-0"

BILL OF MATERIALS

QUANTITY	ITEM
8	1/2"φ Bolts, nuts & washers
4	2"x18"x1/4" Anchors
6	4"x4"-8'-0" Columns
10	2"x10"-8'-0" Joists
2	4"x6"-8'-0" Caps
6	2"x6"-8'-0" Hor. braces
8	2"x4"-10'-0" Diag. braces
68 S.F.	1" Sheathing
68 S.F.	28 Ga. galvanized iron
64 L.F.	3/8"φ Reinforcing steel
8	1/2"x8" Anchor bolts
6	3/4"x12" Lag screws
	Nails
7.5 sks	Cement
0.7 c.y.	Sand
1.2 c.y.	Stone

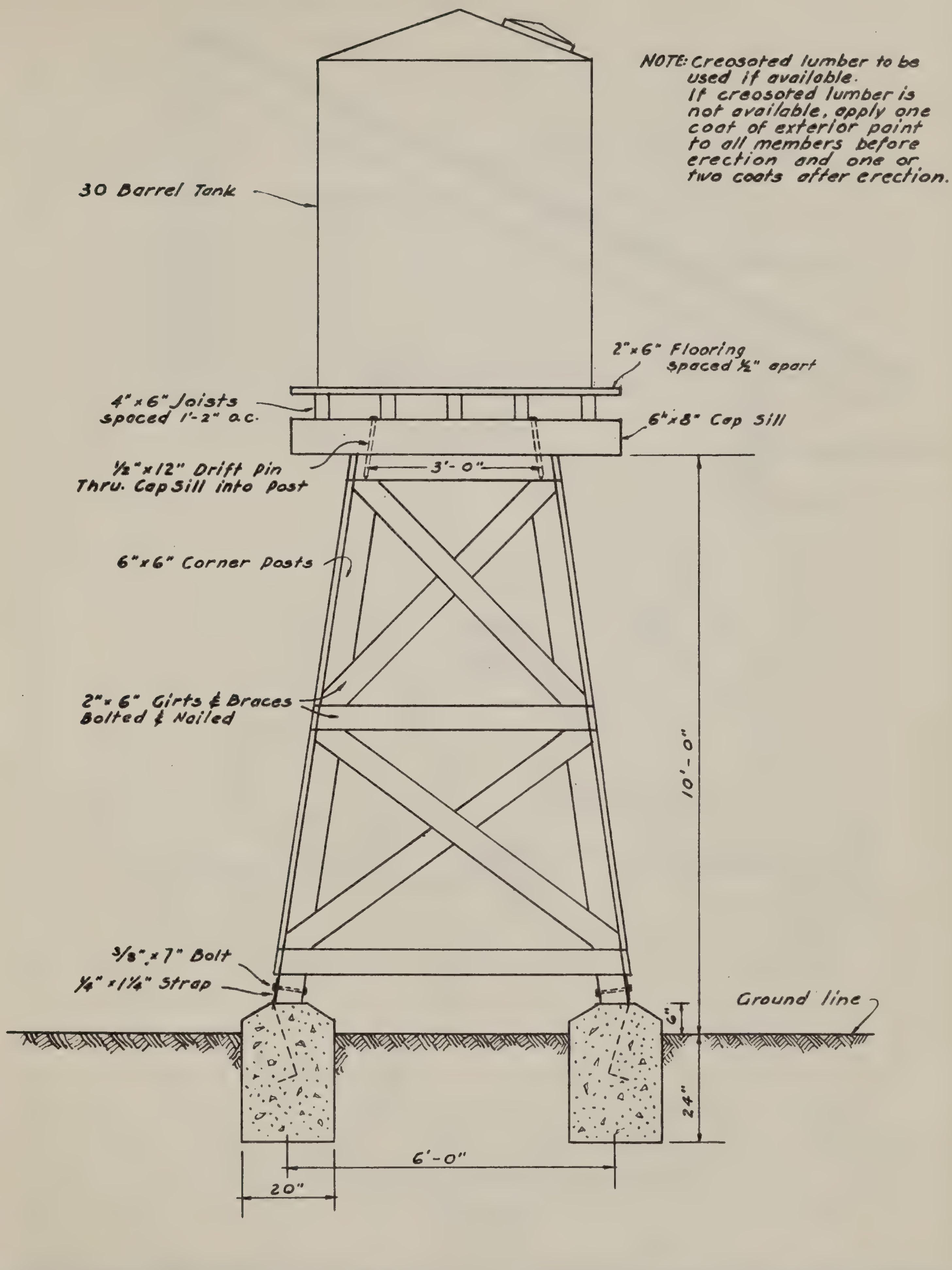
U.S. DEPARTMENT OF AGRICULTURE — FARM SECURITY ADMINISTRATION

TANK TOWER

(for 56 bbl. tank. max.)

REGION 8 — DALLAS TEXAS

FIG. 8

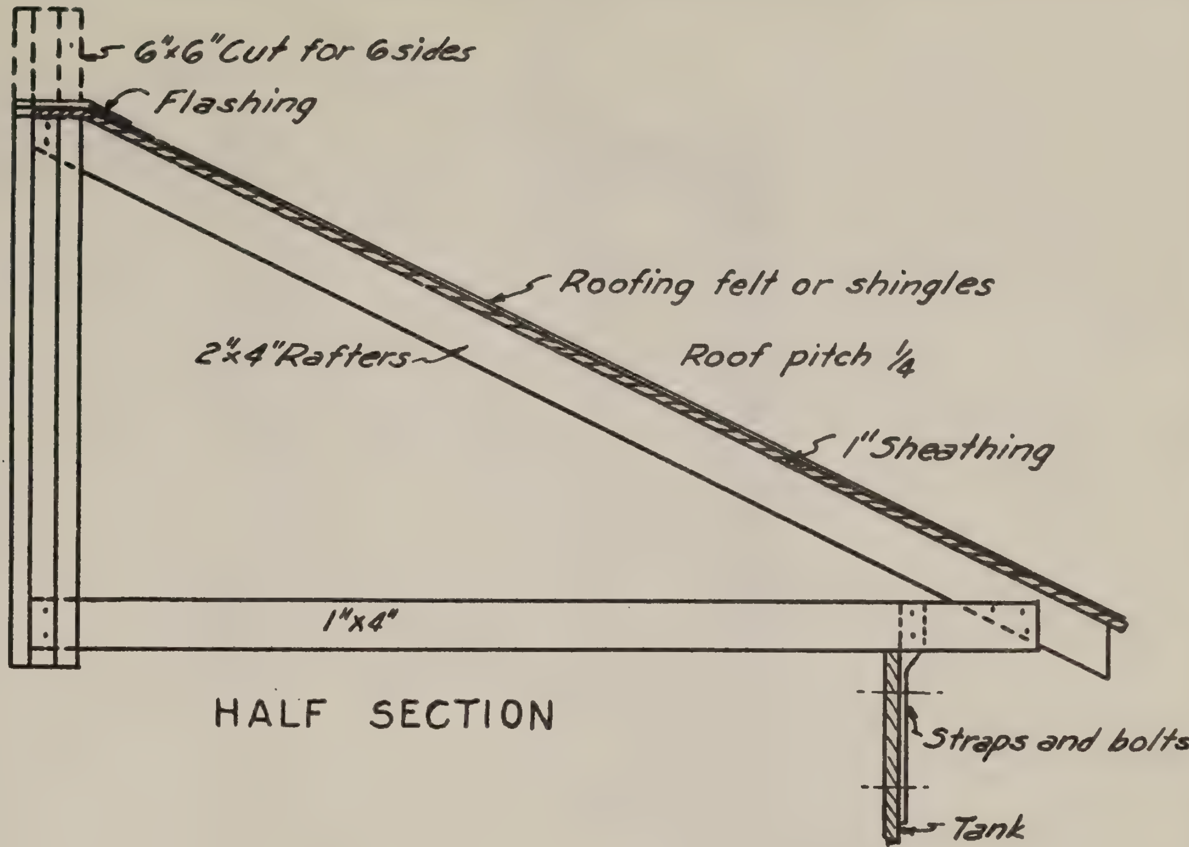


U·S· DEPARTMENT OF AGRICULTURE FARM SECURITY ADMINISTRATION

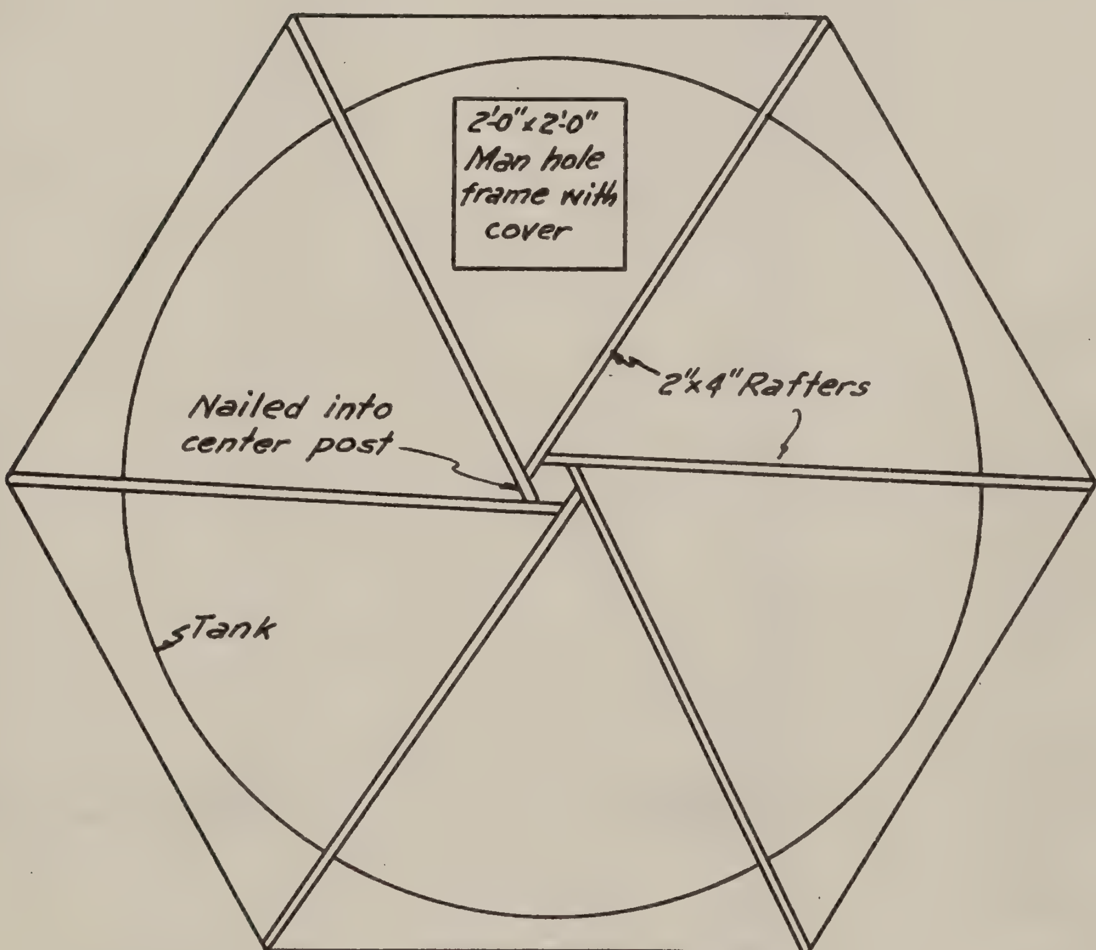
TANK TOWER

REGION 8 DALLAS TEXAS

FIG· 9



HALF SECTION



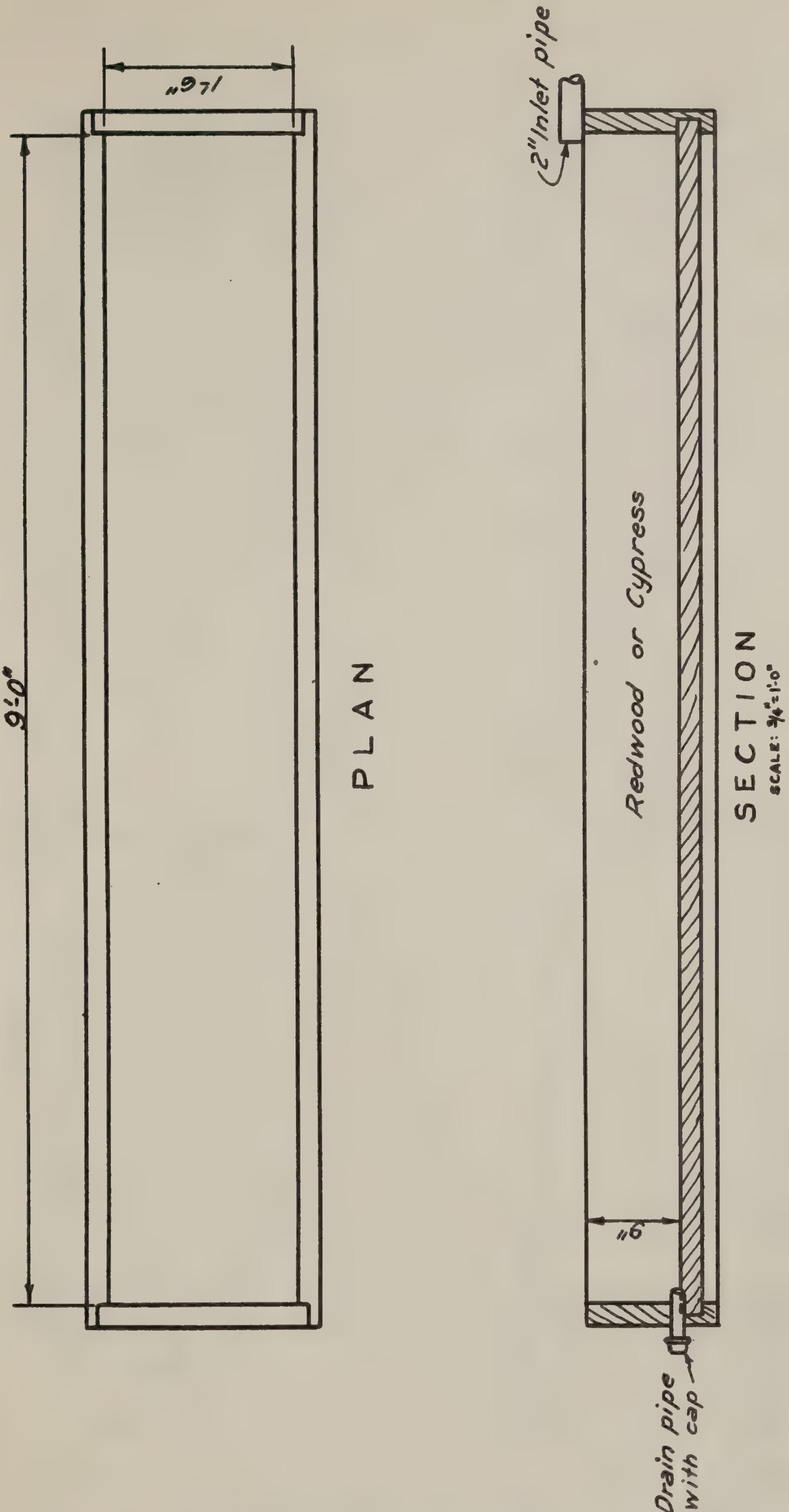
PLAN

U.S. DEPARTMENT OF AGRICULTURE FARM SECURITY ADMINISTRATION

WOOD COVER FOR STORAGE TANK

REGION 8 DALLAS TEXAS

FIG. 10



BILL OF MATERIALS

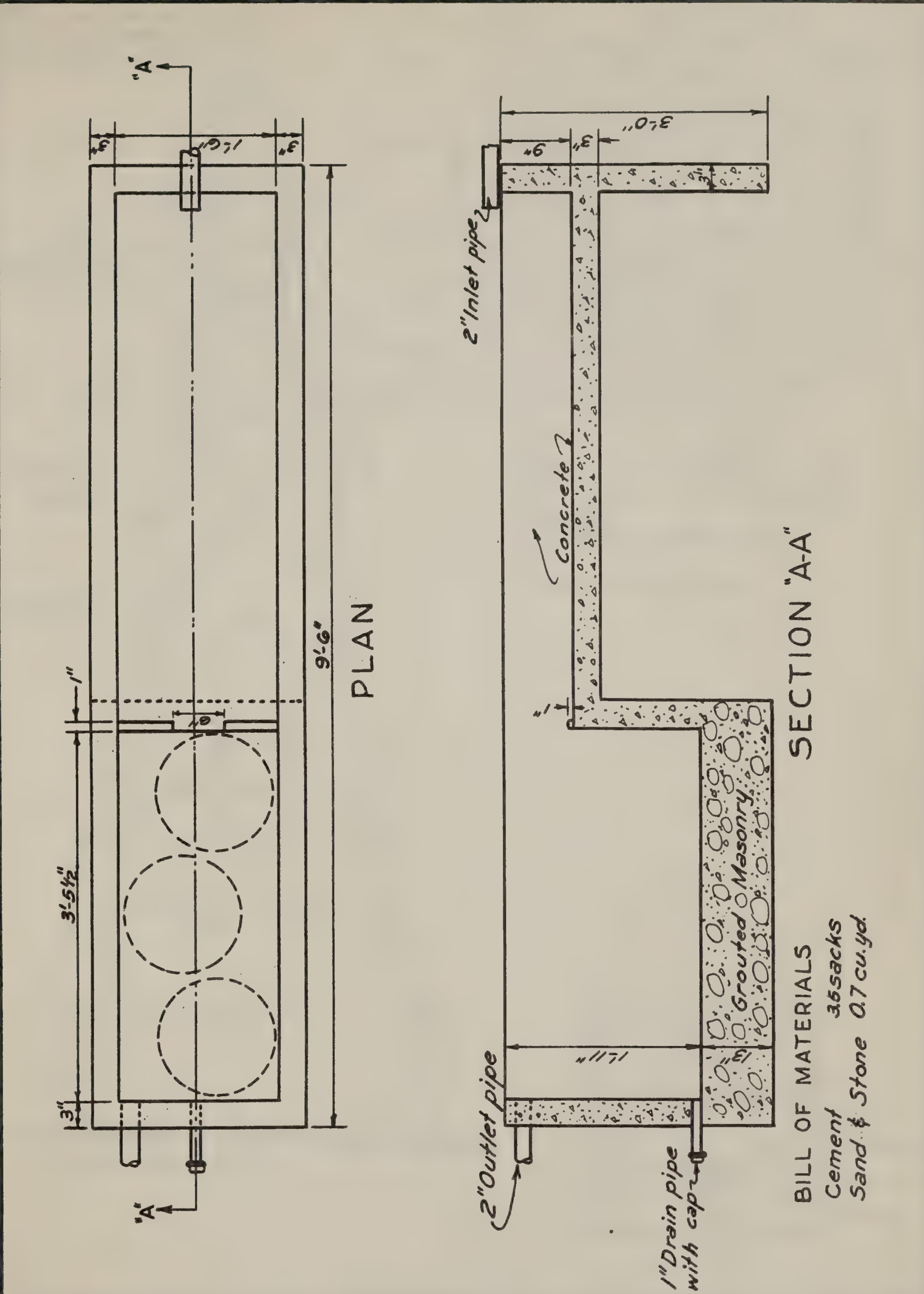
Part	No. Pc.	Size
Bottom	1	2" x 2'-0" x 9'-2"
Ends	2	2" x 1'-0" x 1'-8"
Sides	2	2" x 1'-0" x 9'-4"

U.S. DEPARTMENT OF AGRICULTURE FARM SECURITY ADMINISTRATION

MILK COOLING TROUGH
(Wood)

REGION 8 DALLAS TEXAS

FIG. 11



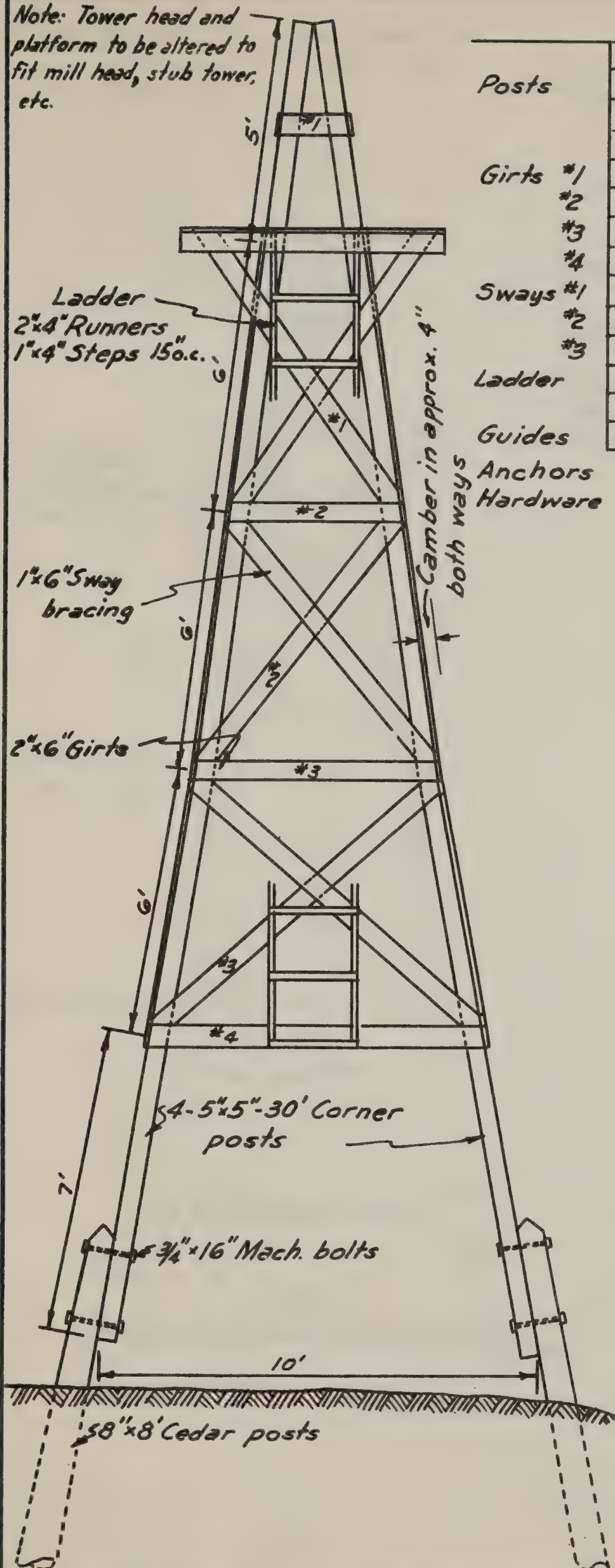
U·S· DEPARTMENT OF AGRICULTURE FARM SECURITY ADMINISTRATION

MILK COOLING TROUGH

(Concrete)

REGION 8 DALLAS TEXAS

FIG. 12



BILL OF MATERIALS

	Pcs.	Dimensions	Grade	F.B.M.
Posts	4	5"x5"x30'		250
	6	2"x6"x 6'	#1 S4S	36
	6	1"x12"x 6'	#2 Boxing	36
Girts #1	6	2"x 6"x 2'	#1 S4S	12
#2	4	2"x 6"x 4'	"	16
#3	4	2"x 6"x 6'	"	24
#4	4	2"x 6"x 8'	"	32
Sways #1	4	1"x 6"x 16'	#1 Rough	32
#2	4	1"x 6"x 16'	"	32
#3	4	1"x 6"x 18'	"	36
Ladder	2	2"x 4"x 20'	#2 S4S	27
	2	1"x 4"x 16'	#1 S4S	11
Guides	2	2"x 6"x 6'	"	12

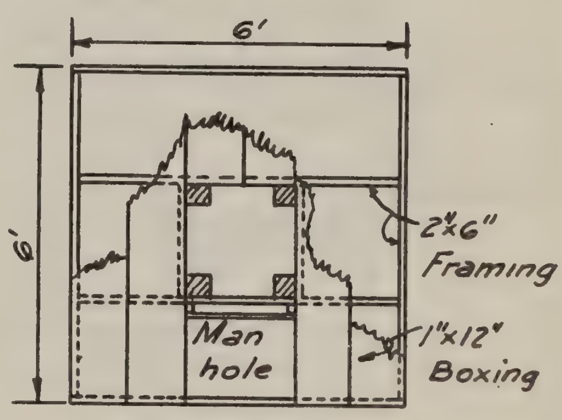
Anchors 4 cedar posts 8" top 8' long
Hardware 8-3/4"x16" machine bolts

Nails

8d	3 lbs.	Ladder
16d	8 "	Sways
20d	10 "	Girts & Ladder

Washers
3/4" Flat wrought 3 lbs.

Paint
3 gals. mixed, barn.



PLATFORM

U.S. DEPARTMENT OF AGRICULTURE FARM SECURITY ADMINISTRATION

WINDMILL TOWER
(Wood - 30')

REGION 8 DALLAS TEXAS

FIG. 13

Note: Tower head and platform to be altered to fit mill head, stub tower, etc.

BILL OF MATERIALS

	Pcs	Dimensions	Grade	F.B.M
Posts	4	5"x5"x25'		208
	6	2"x6"x 6'	#1S4S	36
	6	1"x12"x 6'	#2 Boxing	36
Girts #1	6	2"x6"x 2'	#1S4S	12
#2	4	2"x6"x 4'	"	16
#3	4	2"x6"x 6'	"	24
Sways #1	4	1"x6"x16'	#1 Rgh	32
#2	4	1"x6"x18'	"	34
Ladder	2	2"x4"x20'	#2S4S	27
	2	1"x4"x16'	#1S4S	11
Guides	2	2"x6"x 6'		12

Anchors 4 Cedar posts 8" top 8' long

Hardware 8 3/4"x16" Machine bolts

Nails

8d 2 lbs. Ladder

16d 6 " Sways

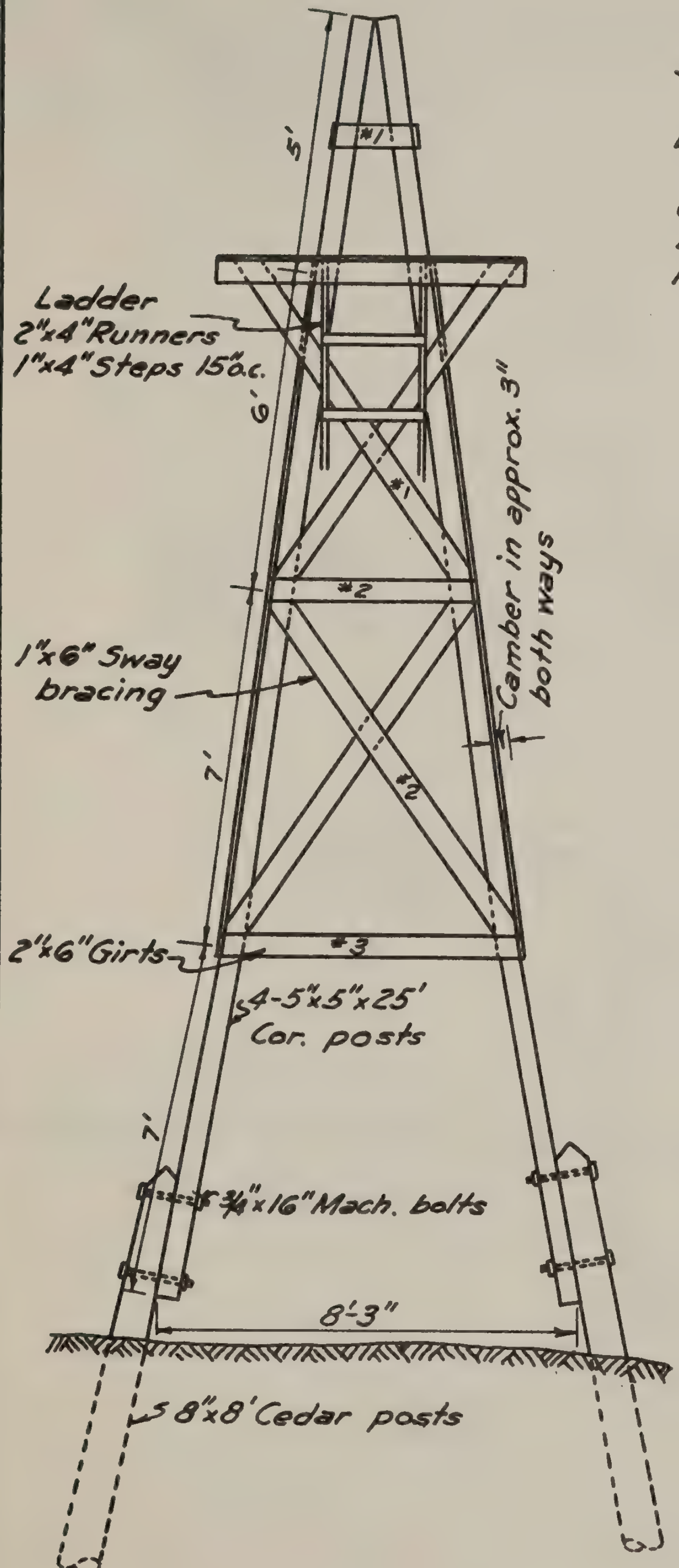
20d 8 " Girts & Ladder

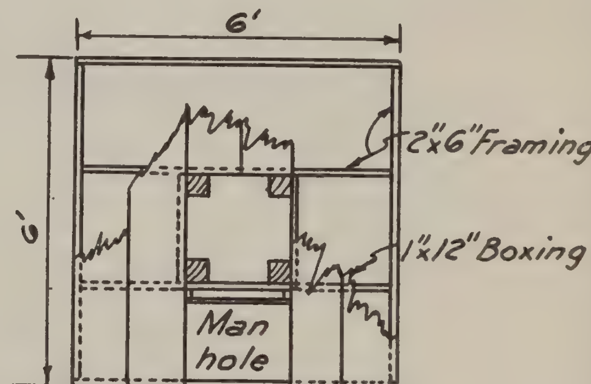
Washers

3/4" Flat wrought 3 Lbs.

Paint

2½ gals. mixed, barn.





PLATFORM

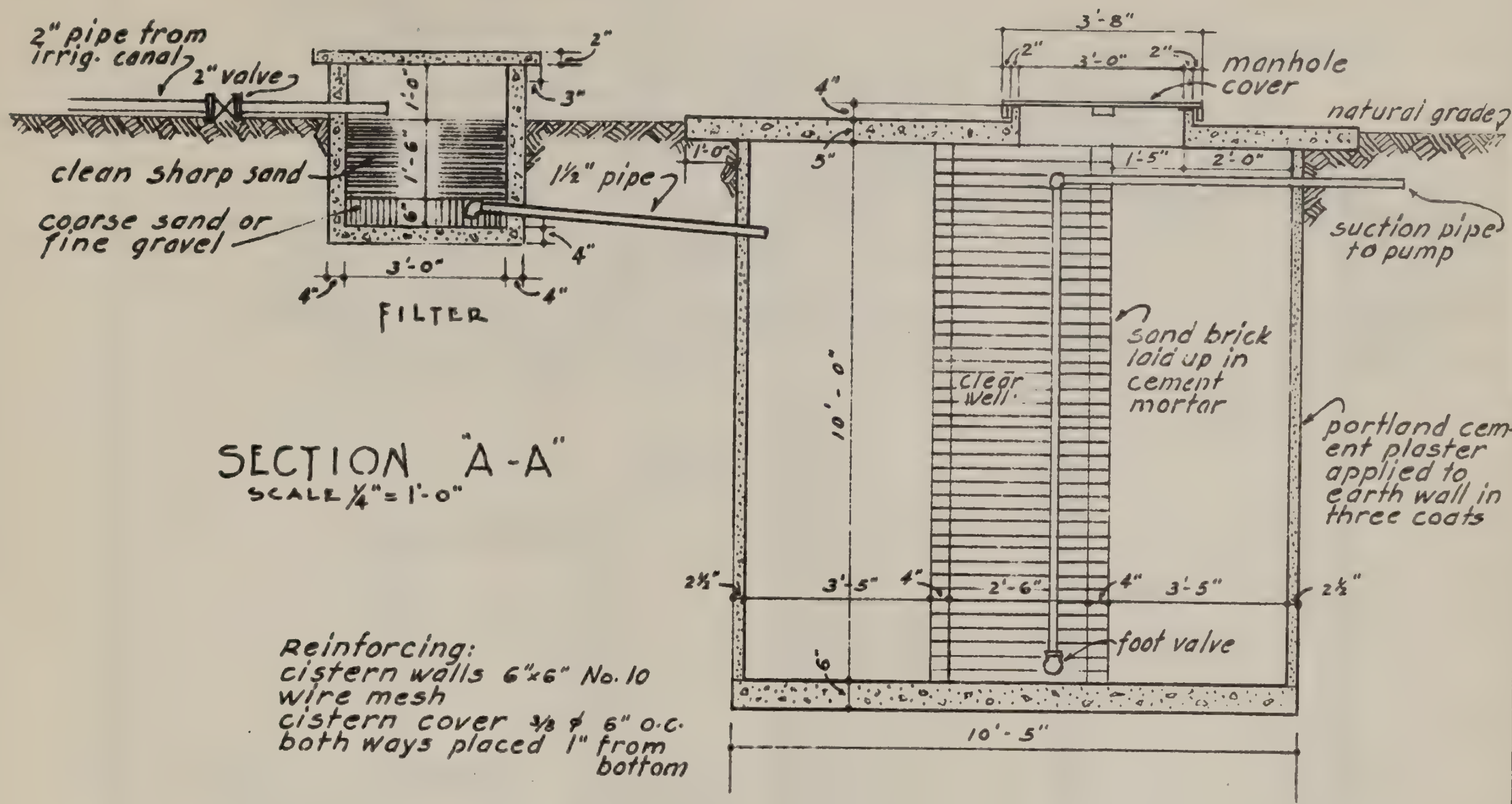
U·S·DEPARTMENT OF AGRICULTURE - FARM SECURITY ADMINISTRATION

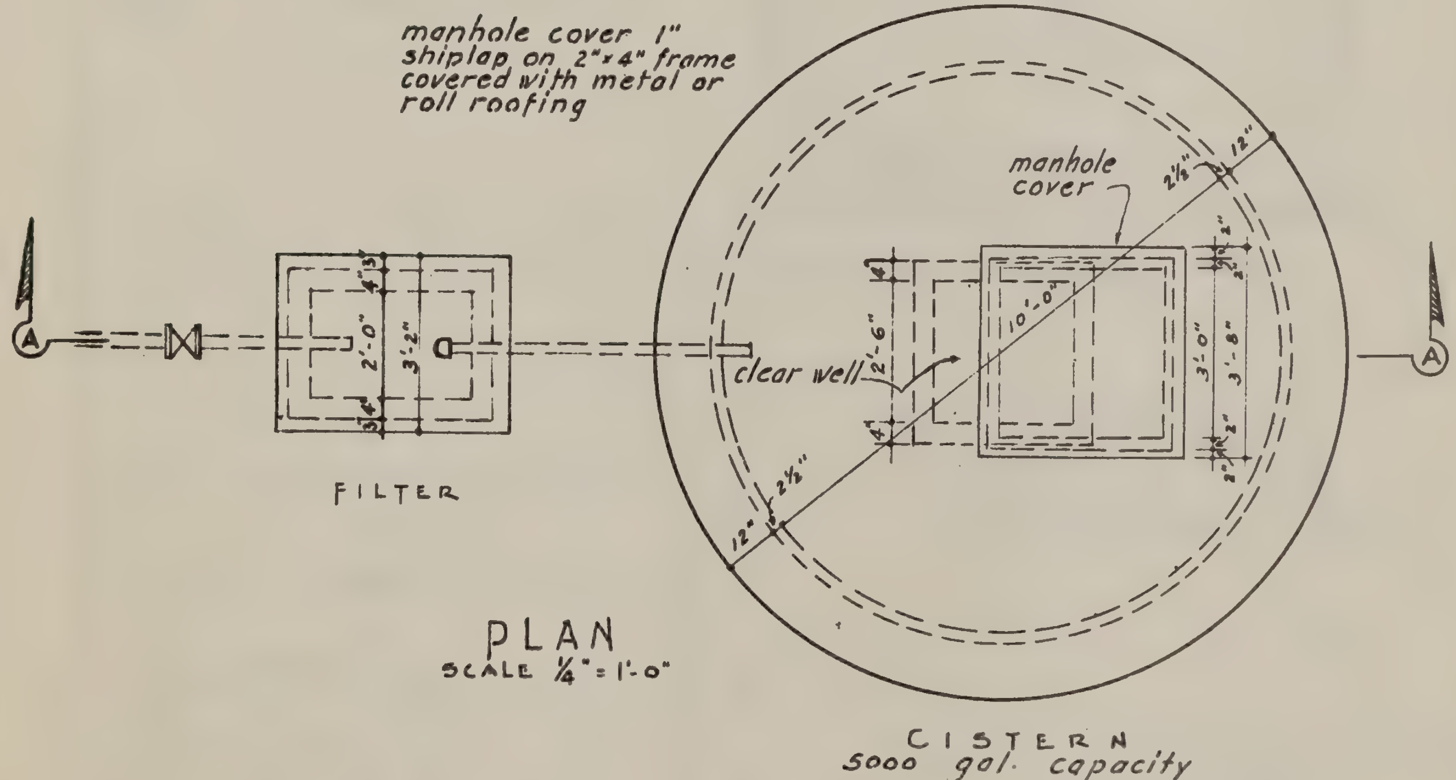
REGION 8

WINDMILL TOWER
(Wood - 25')

DALLAS TEXAS

FIG·14





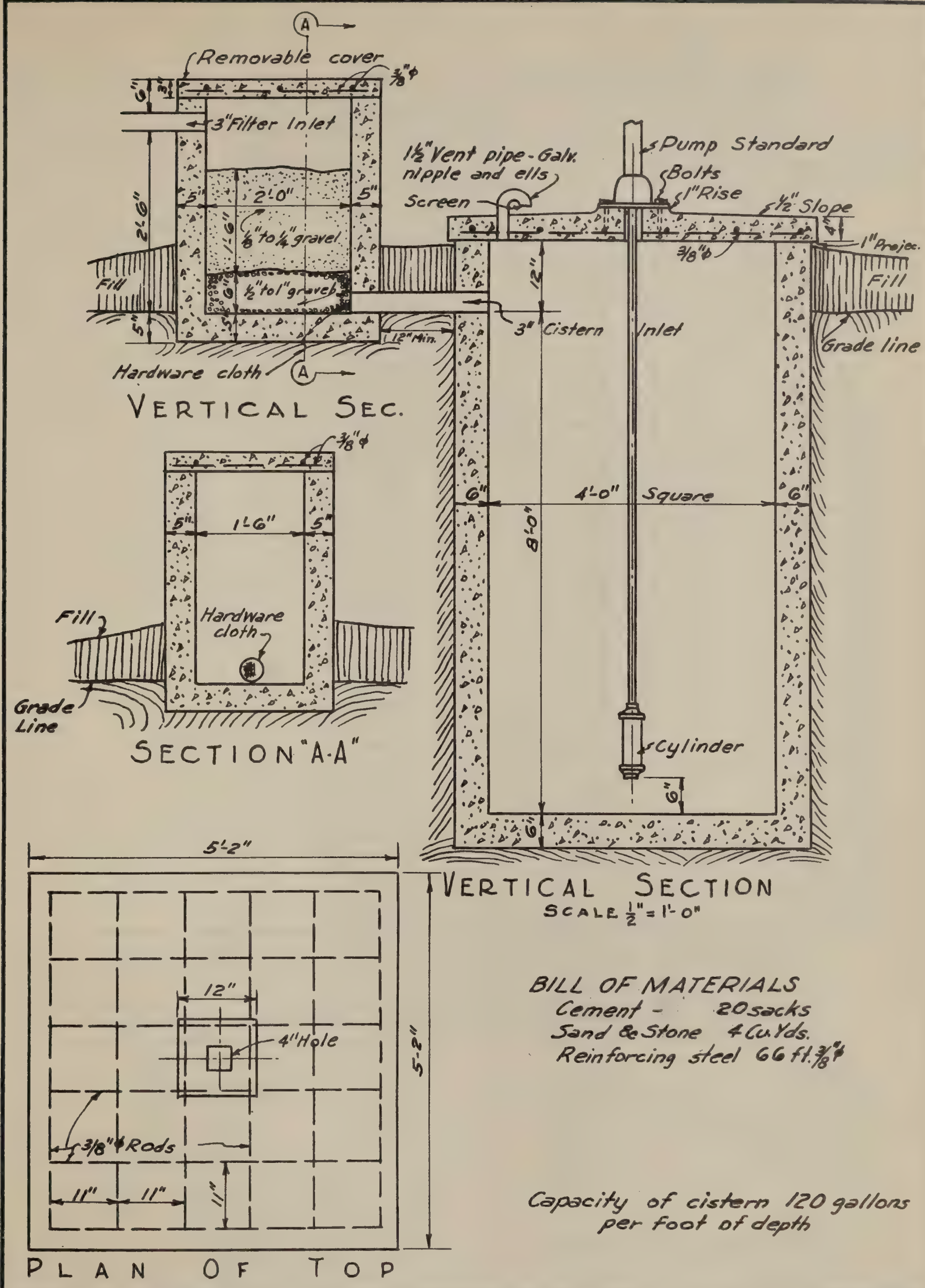
U. S. DEPARTMENT OF AGRICULTURE FARM SECURITY ADMINISTRATION

REGION 8

CISTERN & FILTER

DALLAS TEXAS

FIG. 15

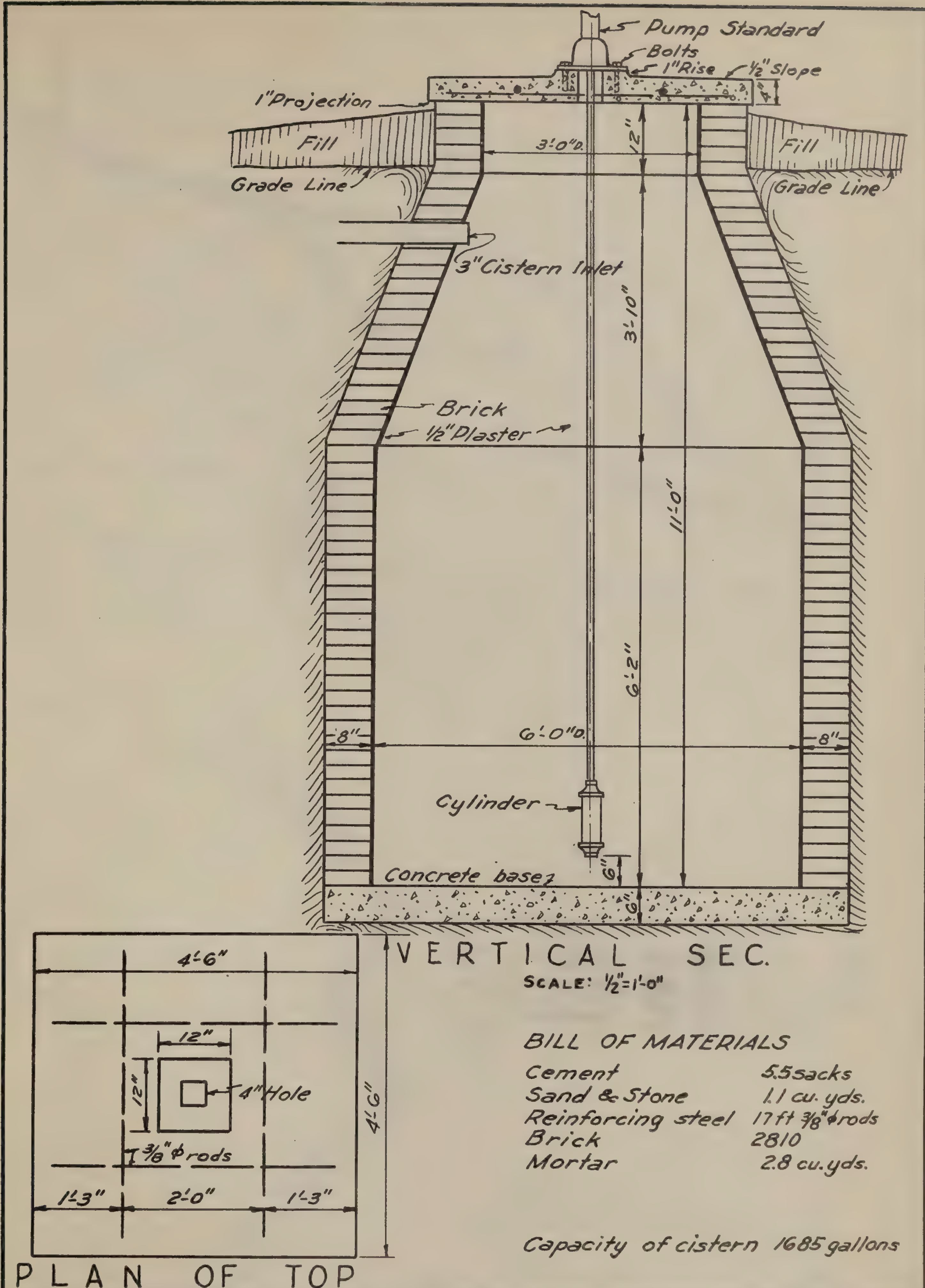


U.S. DEPARTMENT OF AGRICULTURE — FARM SECURITY ADMINISTRATION

CISTERN & FILTER

REGION 8 — DALLAS TEXAS

FIG. 16



BILL OF MATERIALS

Cement	5.5 sacks
Sand & Stone	1.1 cu. yds.
Reinforcing steel	17 ft ⅜" φ rods
Brick	2810
Mortar	2.8 cu. yds.

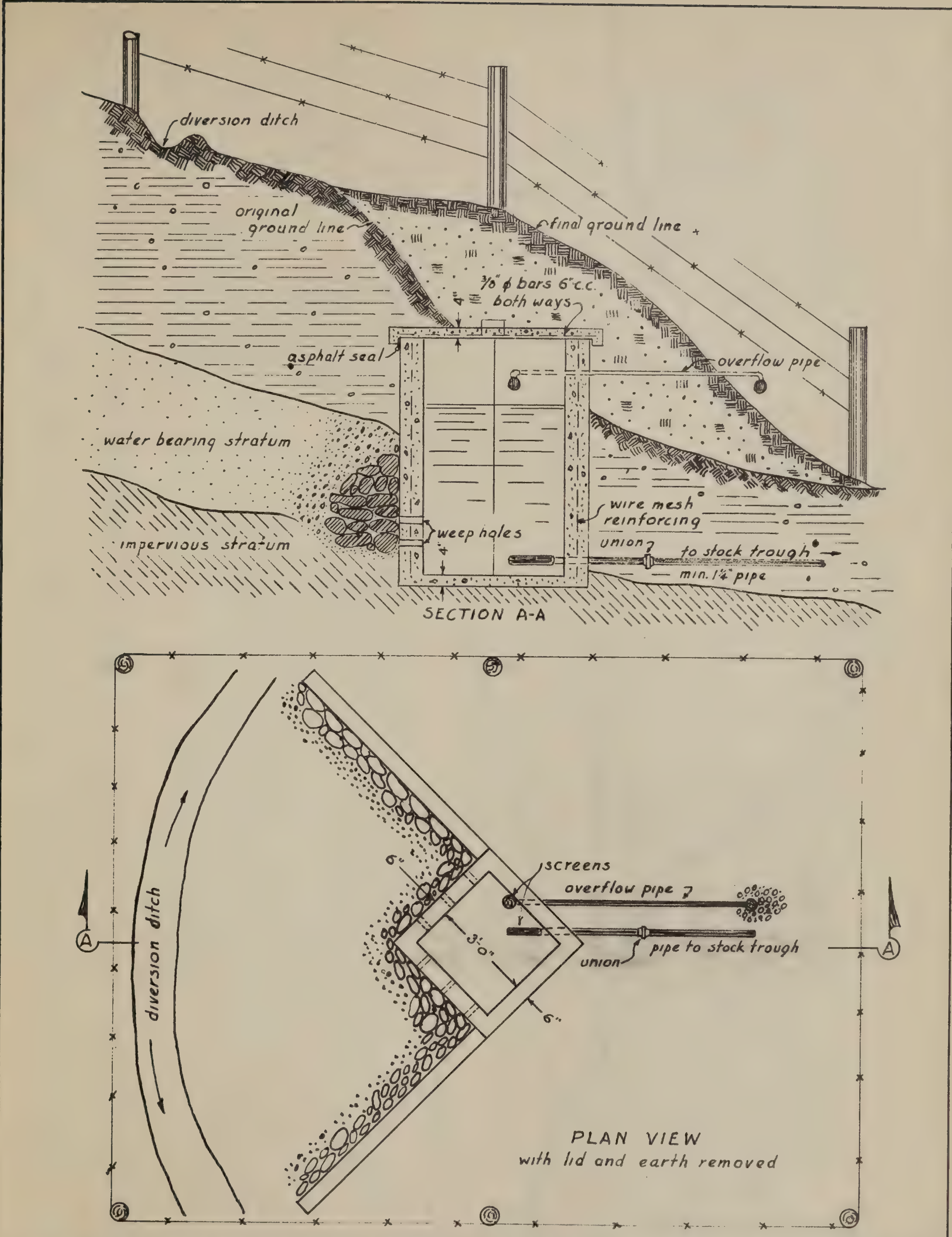
Capacity of cistern 1685 gallons

U·S· DEPARTMENT OF AGRICULTURE — FARM SECURITY ADMINISTRATION

BRICK CISTERN

REGION 8 — DALLAS TEXAS

FIG· 17



U·S· DEPARTMENT OF AGRICULTURE FARM SECURITY ADMINISTRATION

TYPICAL SPRING DEVELOPMENT

REGION 8 DALLAS TEXAS

FIG· 18

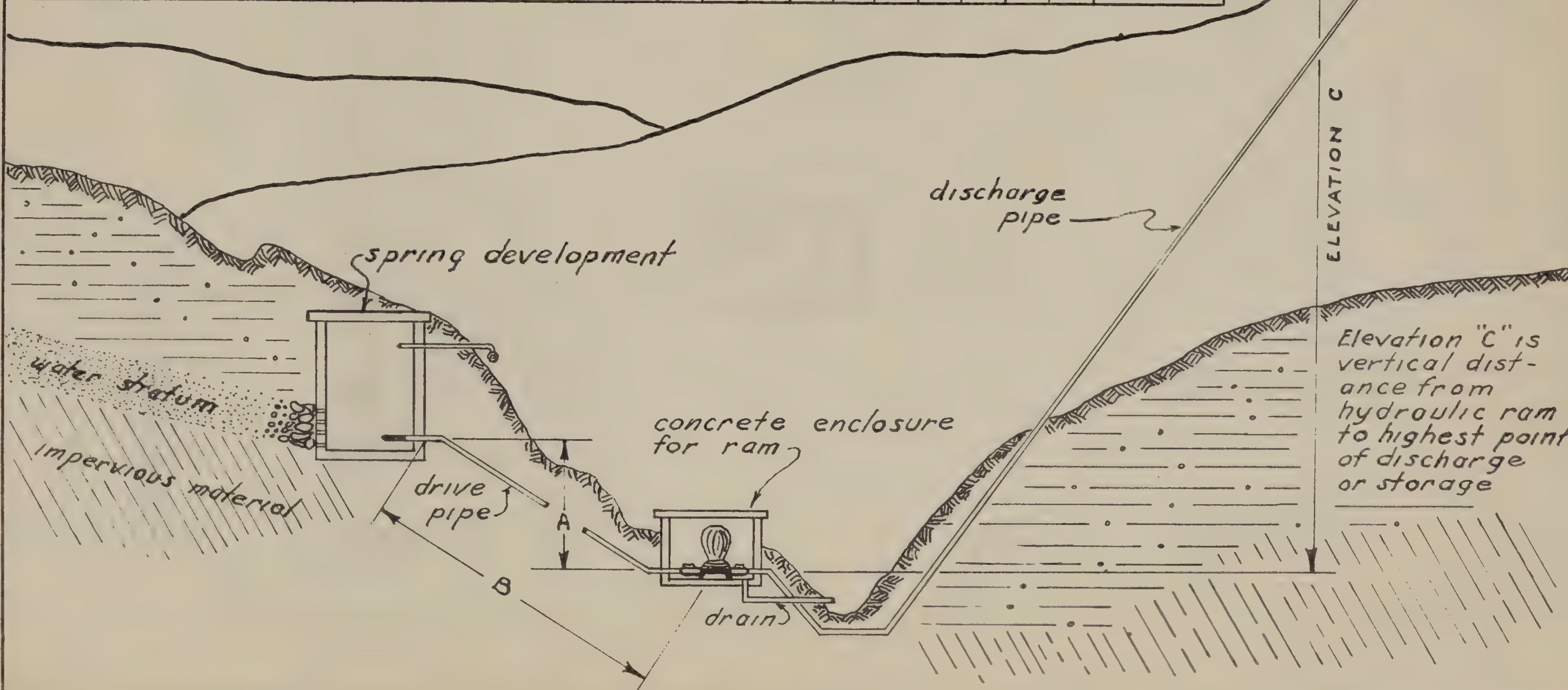
TO DETERMINE OUTPUT OF RAM

Multiply number of gallons supplied to the ram per minute by the number below for any given fall (A) and elevation (C) result will be approximate number of gallons delivered per hour

A	ELEVATION C: 12	15	18	21	24	27	30	33	36	39	42	45	48	54	60	66	72	84	96	108	120	132	144	B
2	5.	4.	3.3	3.	2.5																			10 to 20
3			5.	4.3	3.7	3.3	3.	2.7	2.5															15 to 30
4					5.	4.4	4.	3.6	3.3	3.1	2.8	2.6	2.5											20 to 40
5							5.	4.5	4.2	3.8	3.6	3.3	3.1	2.8	2.5									25 to 50
6									5.	4.6	4.3	4.	3.7	3.3	3.	2.7	2.5							30 to 60
7											5.	4.7	4.4	3.9	3.5	3.2	3.	2.5						35 to 70
8													5.	4.4	4.	3.6	3.3	2.9	2.5					40 to 80
9														5.	4.5	4.1	3.8	3.2	2.8	2.5				45 to 90
10															5.	4.5	4.2	3.6	3.1	2.8	2.5			50 to 100
11																5.	4.6	4.	3.4	3.	2.8	2.5		55 to 110
12																	5.	4.3	3.8	3.3	3.	2.7	2.5	60 to 120

APPROXIMATE RAM SIZES

RAM NO.	G.P.M. SUPPLIED	PIPE SIZE DRIVE	PIPE SIZE DISCH.
2	½ to 2	¾"	½"
3	1½ to 4	1"	½"
4	3 to 7	1½"	¾"
5	6 to 14	2"	1"
6	12 to 25	2½"	1¼"



U. S. DEPARTMENT OF AGRICULTURE FARM SECURITY ADMINISTRATION

HYDRAULIC RAM

REGION 8 DALLAS·TEXAS

FIG. 19

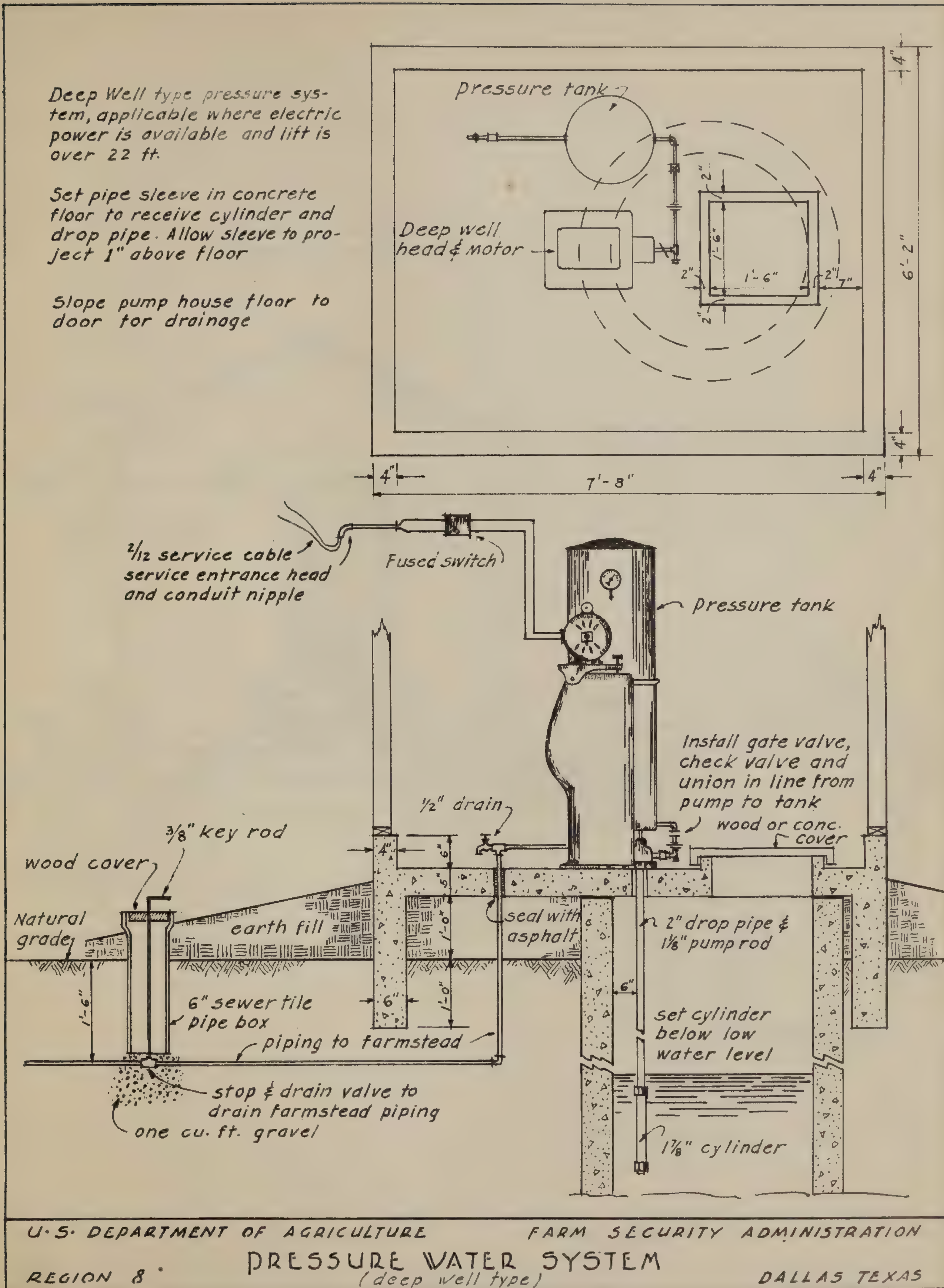
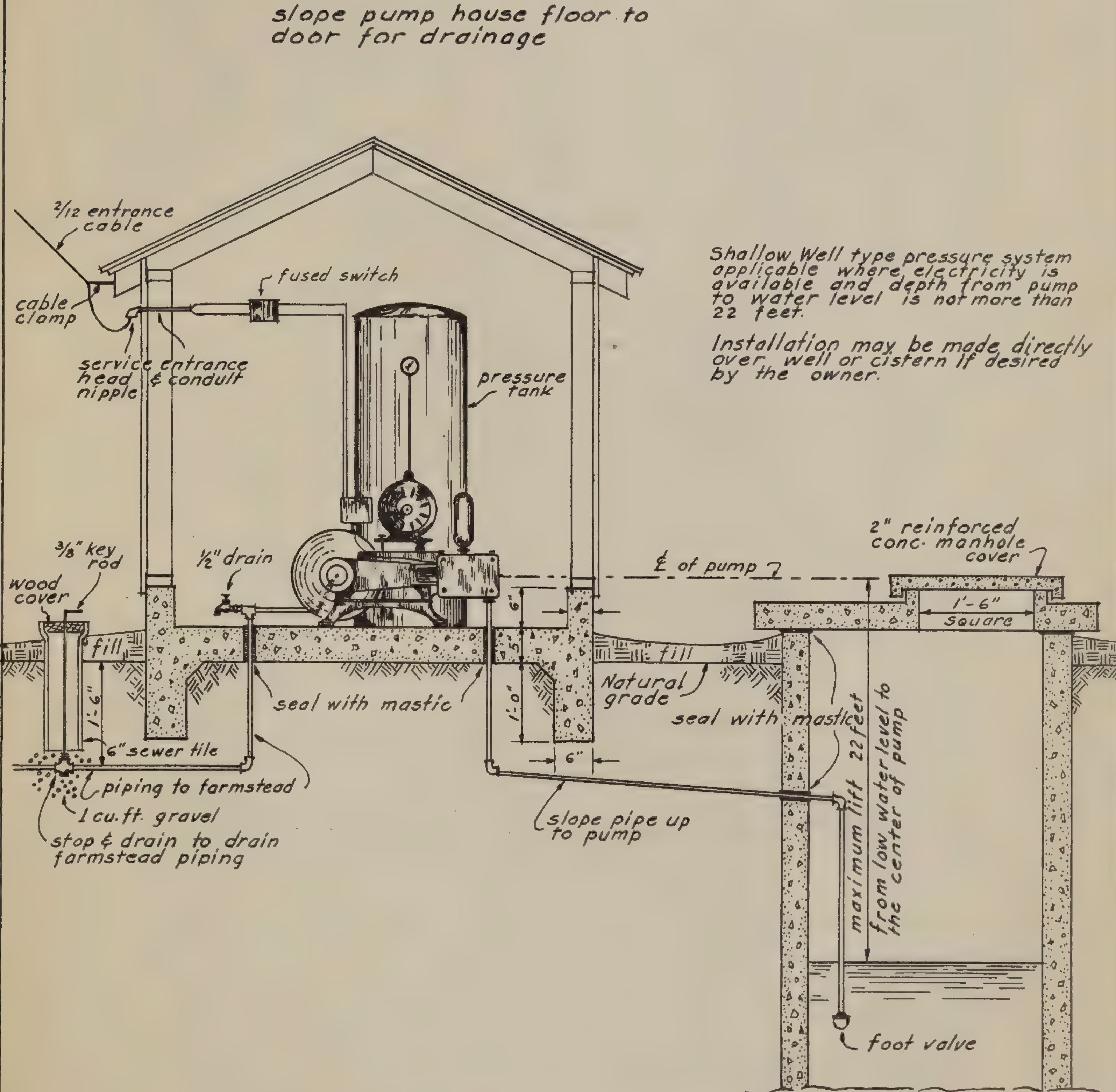

Deep Well type pressure system, applicable where electric power is available and lift is over 22 ft.
Set pipe sleeve in concrete floor to receive cylinder and drop pipe. Allow sleeve to project 1" above floor
Slope pump house floor to door for drainage
pressure tank
Deep well head & motor
2"
1'-6"
1'-6"
2"
2"
7"
6'-2"
4"
4"
4"
7'-8"
4"
2/12 service cable
service entrance head and conduit nipple
Fused switch
Pressure tank
Install gate valve, check valve and union in line from pump to tank
wood or conc. cover
1/2" drain
3/8" key rod
wood cover
Natural grade
earth fill
seal with asphalt
2" drop pipe & 1 1/8" pump rod
6"
1'-0"
1'-0"
6"
5"
4"
1'-6"
6" sewer tile pipe box
piping to farmstead
set cylinder below low water level
stop & drain valve to drain farmstead piping
one cu. ft. gravel
1 7/8" cylinder
U.S. DEPARTMENT OF AGRICULTURE
FARM SECURITY ADMINISTRATION
PRESSURE WATER SYSTEM
(deep well type)
REGION 8
DALLAS TEXAS

FIG. 20



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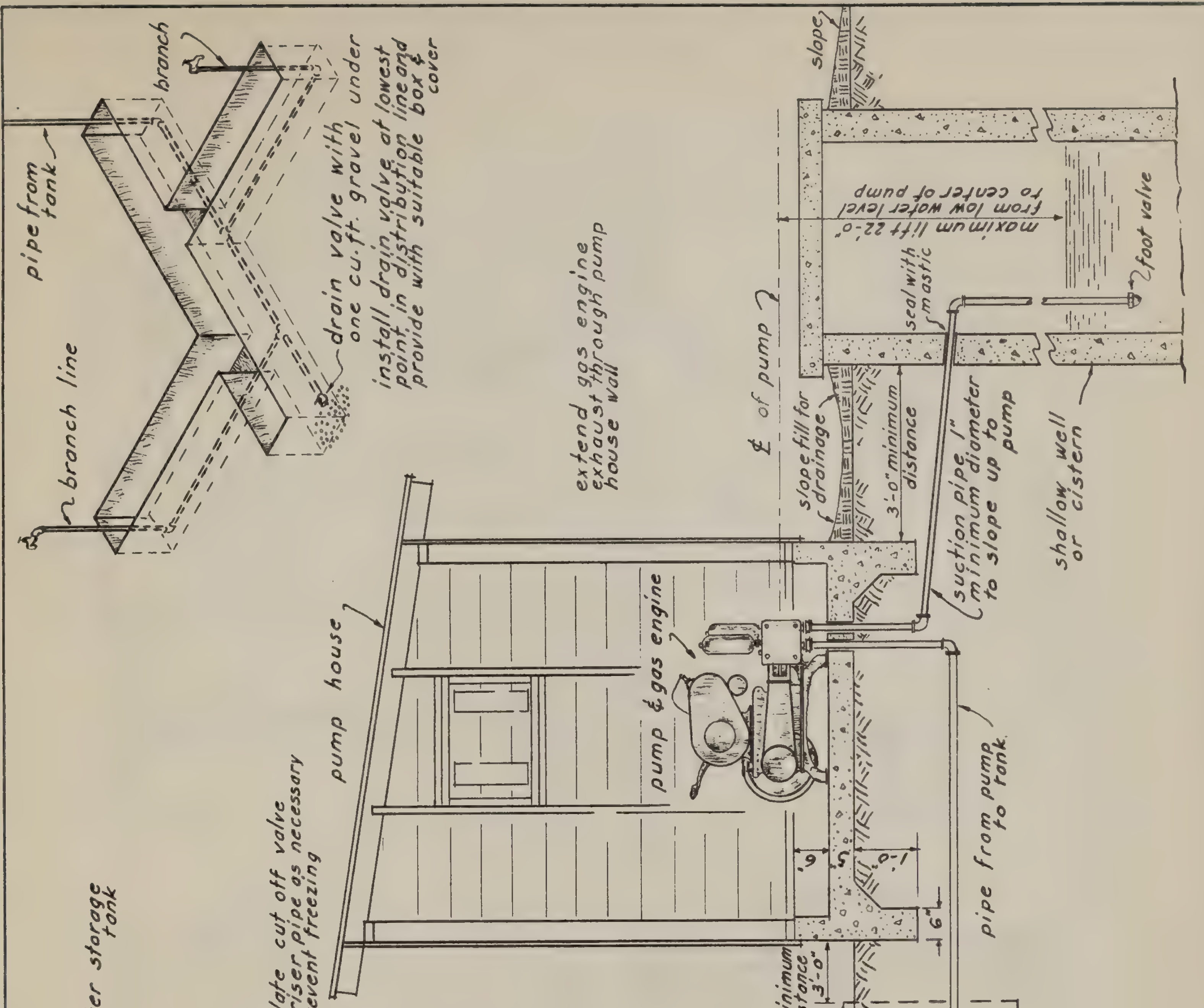
PRESSURE WATER SYSTEM
(suction type)

REGION 8 DALLAS TEXAS

FIG·21



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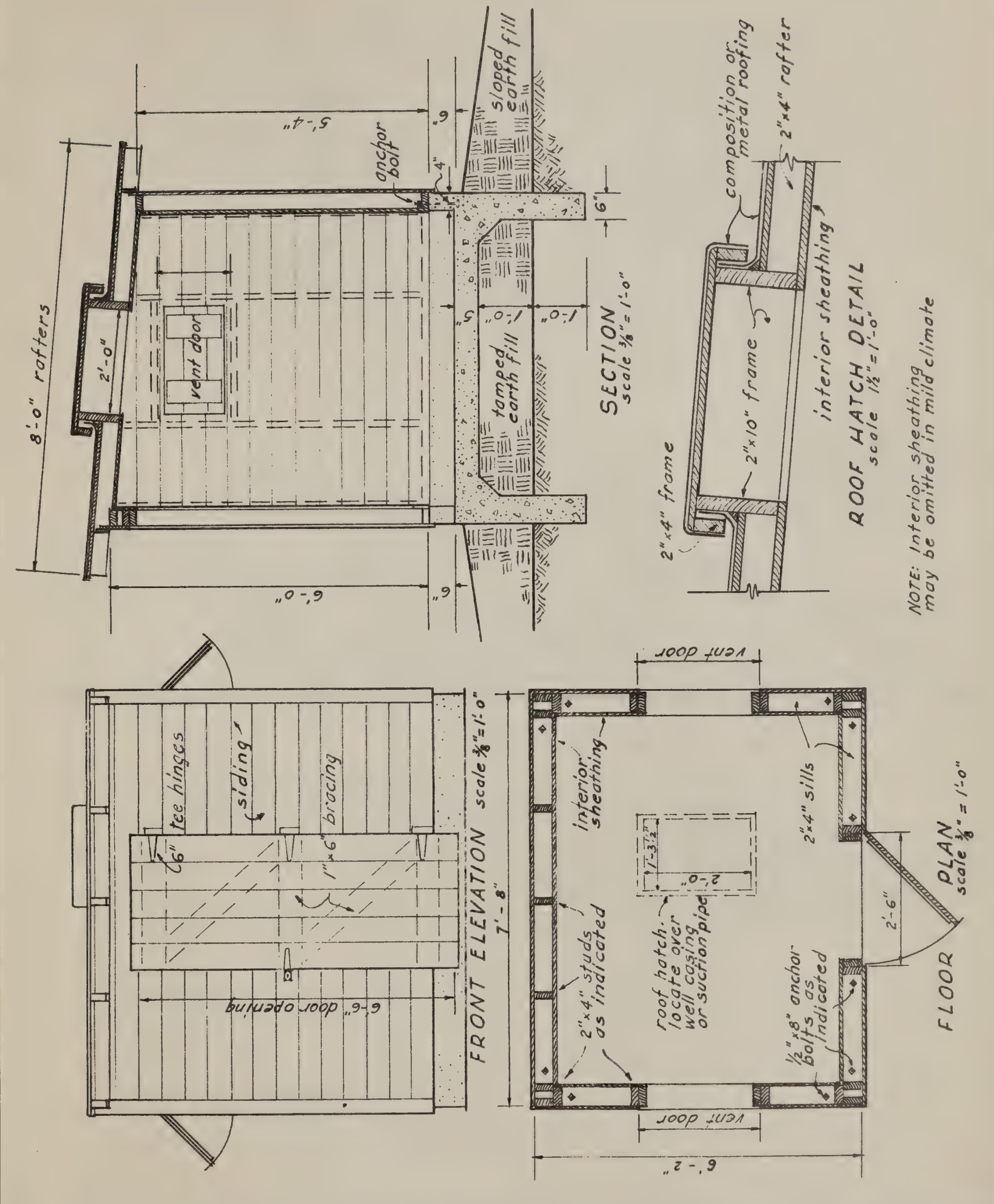
REGION 8

ELEVATED WATER STORAGE
(suction pump & gas engine)

DALLAS TEXAS

FIG· 22



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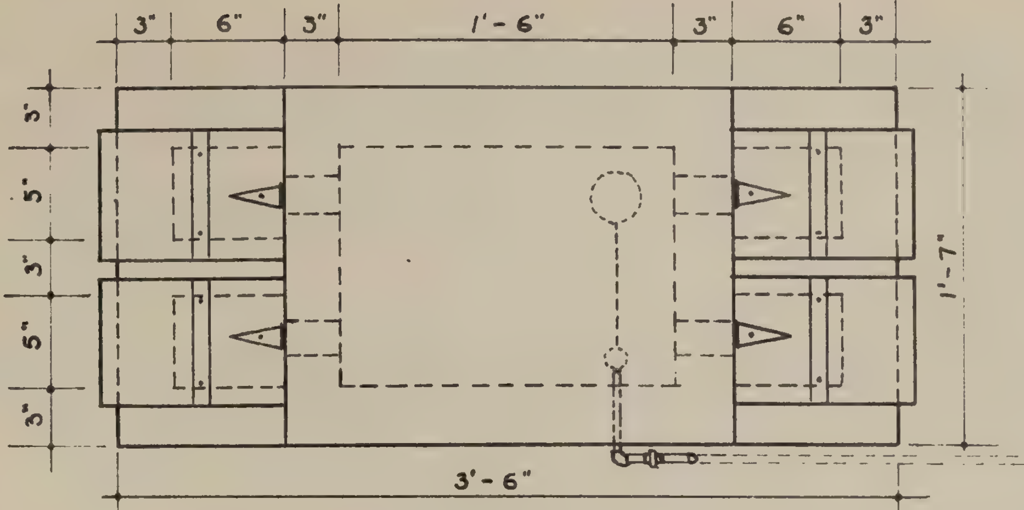
PUMP HOUSE

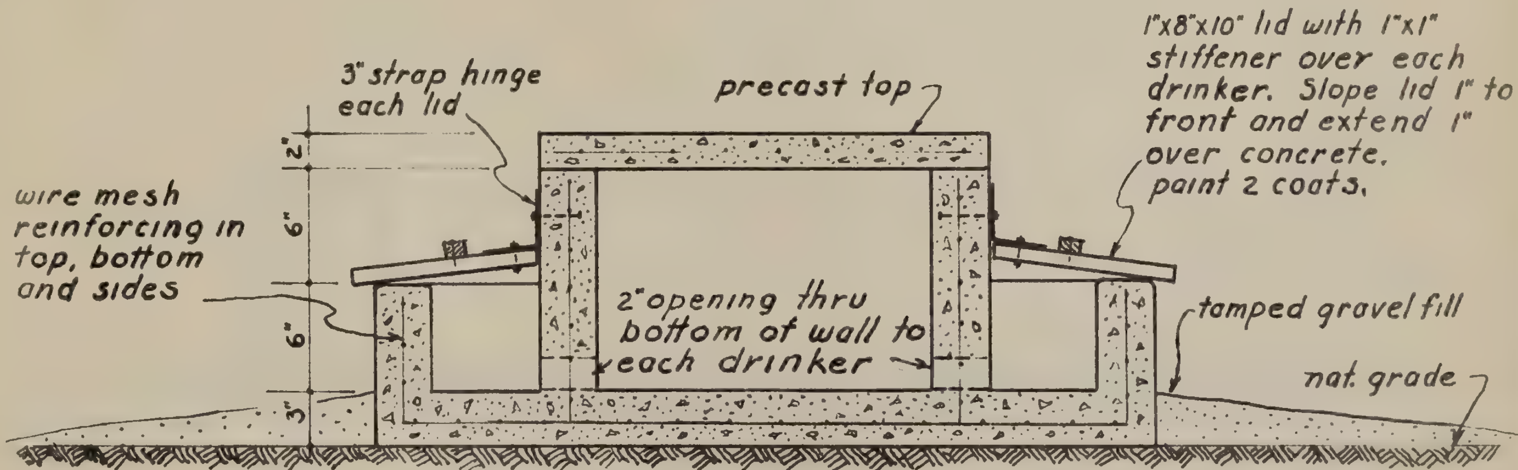
REGION 8

DALLAS TEXAS

FIG·23



PLAN



SECTION

BILL OF MATERIALS

DESCRIPTION	UNIT	NO. OF UNITS
gravel	cu.ft.	3.25
sand	" "	2.25
cement	sks.	1.1
lumber:		
1"x8"	lin. ft	4.0
1"x6"	" "	60.0
2"x4"	" "	16.0
nails	lb	.5
3" strap hinges	ea.	4
¼" x 3" bolts	"	4
¼" x 1½" bolts	"	4
1½" wood screws	"	8
wire mesh	sq. ft	14
¾" float valve assembly	ea.	1
¾" pipe & fittings as shown		

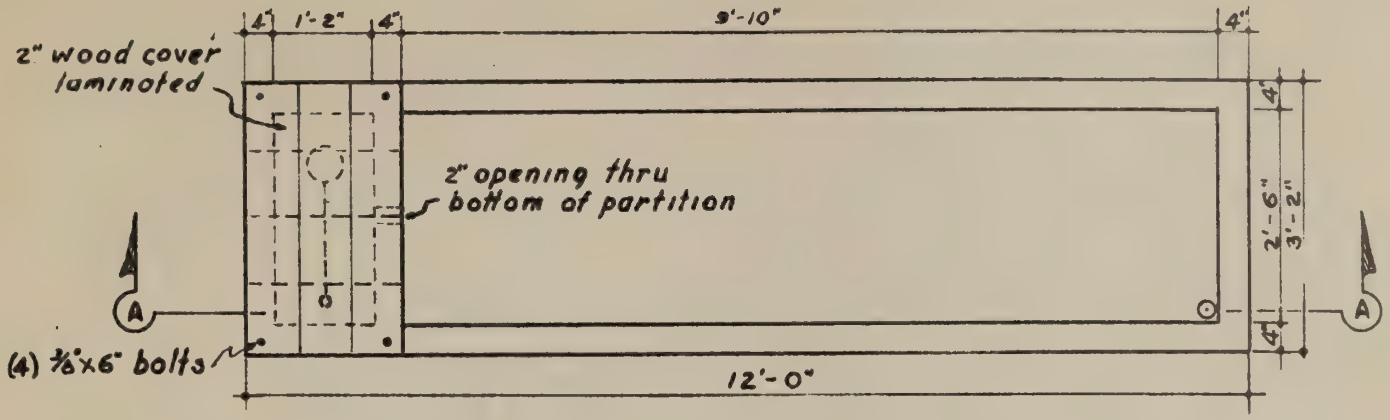
NOTE:
install float valve assembly thru bottom or side wall, placing valve 9" above bottom. adjust float rod to give 5" depth of water.

U. S. DEPARTMENT OF AGRICULTURE FARM SECURITY ADMINISTRATION

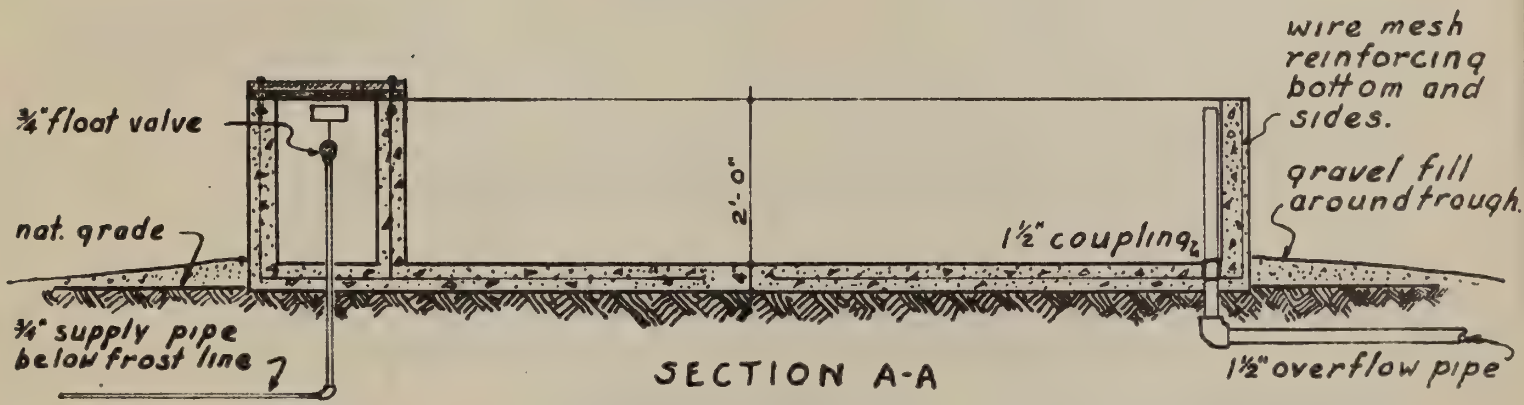
HOG WATERER
(concrete)

REGION 8 DALLAS TEXAS

FIG. 24



PLAN



SECTION A-A

BILL OF MATERIALS

DESCRIPTION	UNIT	NO.
cement	sks.	7
sand	C.Y.	0.5
gravel	C.Y.	1.1
wire mesh	sq.ft	100.0
lumber for cover		
1"x8"x3'-2"	pcs.	3
1"x10"x1'-10"	pcs.	4
lumber for forms		
1"x6"	lf	250.0
2"x4"	lf	80.0
nails	lbs.	2.0
3/8"x6" bolts	ea.	4
3/4" float valve assembly	ea.	1
3/4" supply pipe	lf	5
1½" overflow pipe	lf	5
fittings as shown		

GENERAL NOTES

All concrete should be in the proportion of 1 part cement: 2 parts sand: 3 parts gravel.
Remove outside forms following day after concrete is poured and smooth outside surfaces and round off edges.
Place 1½" coupling even with floor of trough.
The bottom of the trough should be poured first and the walls brought up monolithic. When walls are poured separate a 1"x2" keyway should be formed as a construction joint between the contact surfaces of the walls and bottom.

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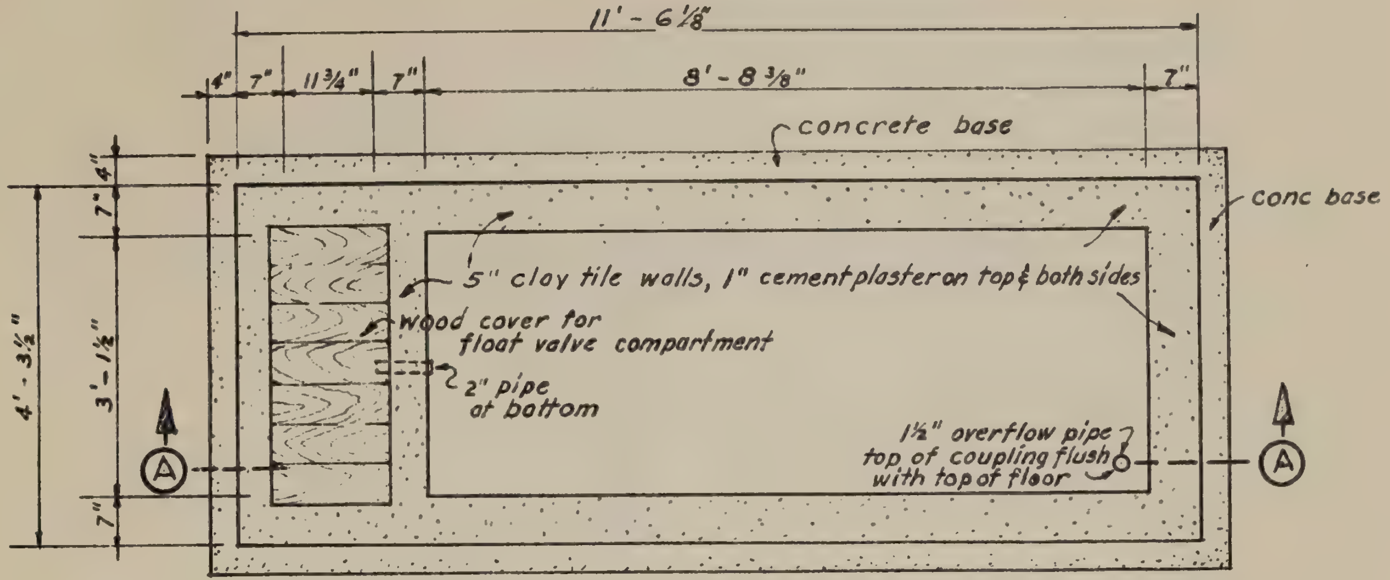
REGION 8

STOCK TROUGH
(concrete)

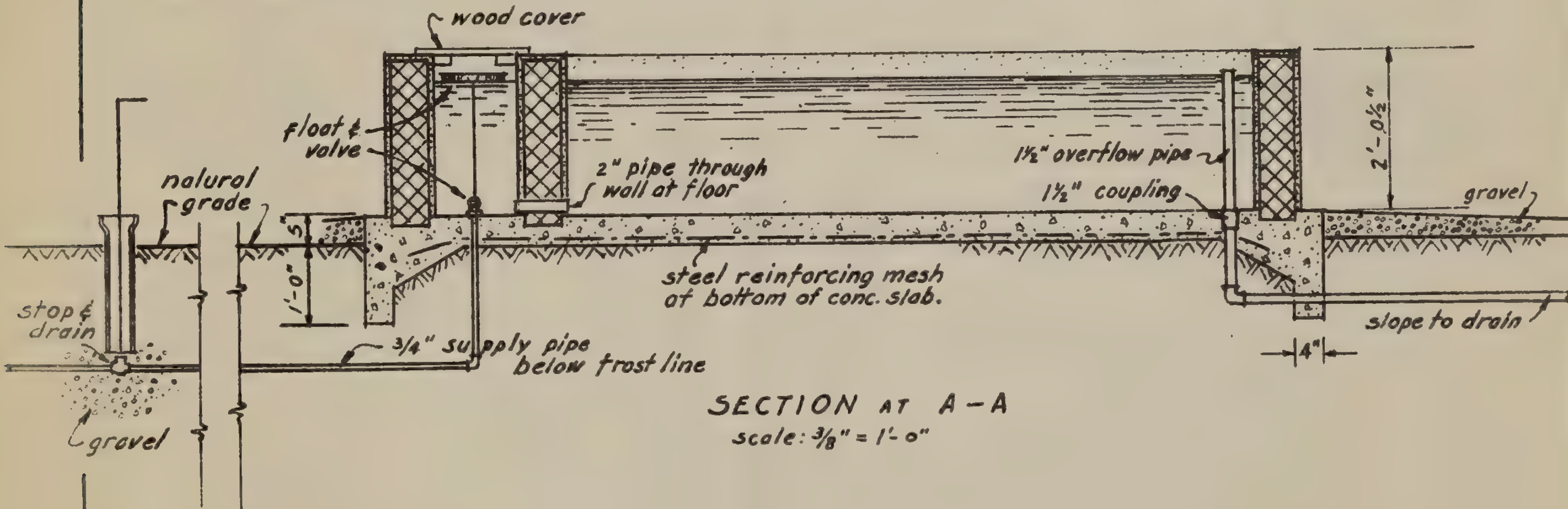
DALLAS TEXAS

FIG. 25



PLAN
scale: 3/8" = 1'-0"

Dimensioned for 5"x8"x12" tile set on edge and with 3/8" mortar joints - 1" cement plaster on interior and exterior.



SECTION AT A – A
scale: 3/8" = 1'-0"

CONSTRUCTION DATA

Conc. to be 1 part cement to 5 parts clean pit run gravel with minimum water to make a stiff mix.
Tile to be standard grade unglazed, grooved clay tile.
Mortar and plaster to be 1 part cement to 2½ parts clean sand with lime in the ratio of one part lime to ten parts cement.
Use 2"x6"s to form construction joints for tile in conc. floor and carefully remove when concrete has set.

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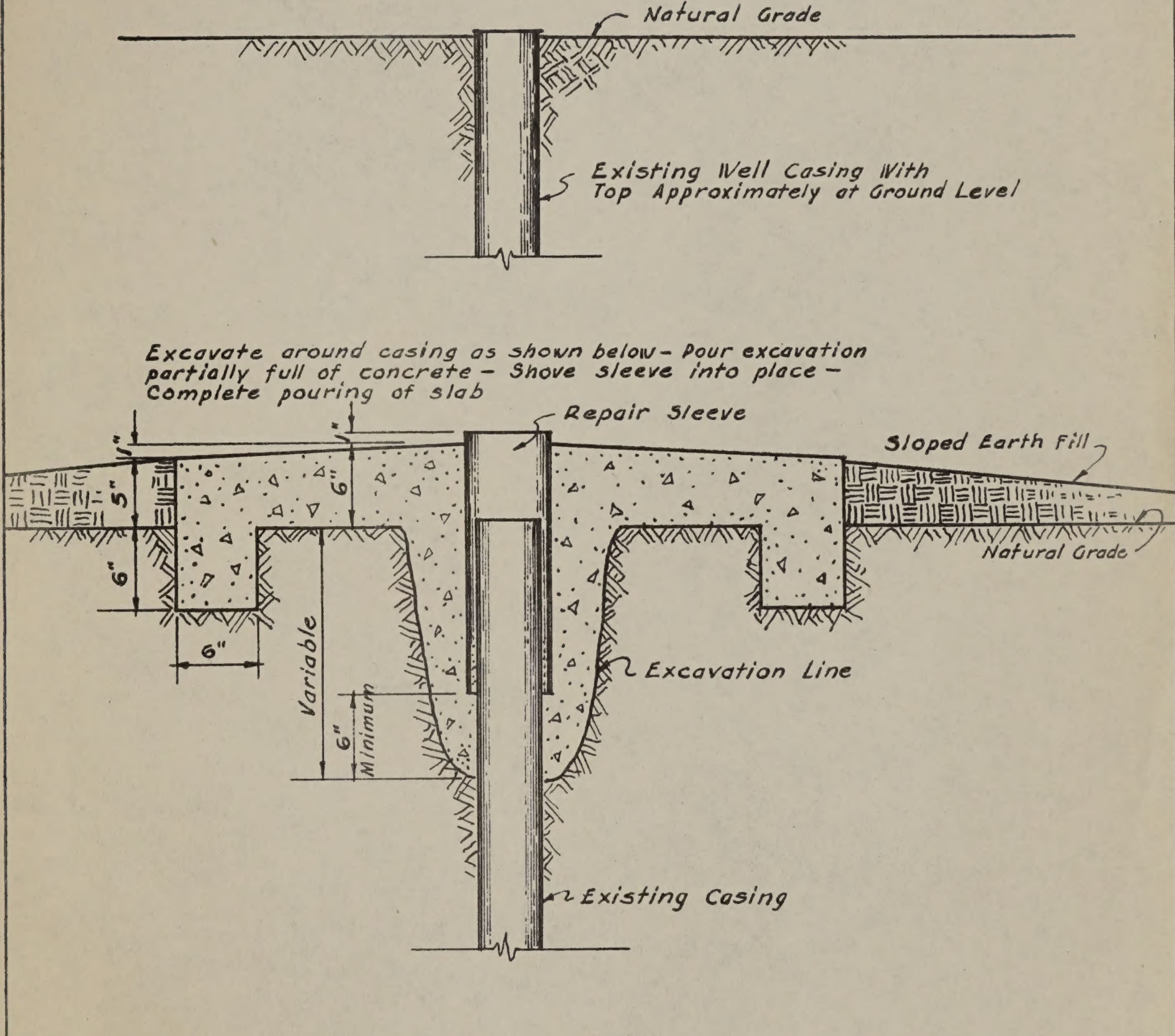
REGION 8 — **TILE STOCK TROUGH** — DALLAS TEXAS

FIG. 26



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CASING REPAIR

REGION 8 DALLAS TEXAS

FIG. 27